870 KF Titrino plus



Manual

8.870.8005EN

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1 Introduction

1.1 Instrument description

The 870 KF Titrino plus is an instrument used for volumetric water content determination according to Karl Fischer. There are method templates available which are already configured except for a few parameters. If parameters are changed, then these will be saved automatically. The methods can be exported to a connected USB flash drive. This function makes it possible for you to copy methods quickly and easily from one instrument to another.

1.1.1 Titration and measuring modes

The following titration and measuring modes are supported:

- **KFT**
  Volumetric water content determination according to Karl Fischer.
  Measuring modes:
  - **Ipol** (voltametric measurement with selectable polarization current)
  - **Upol** (amperometric measurement with selectable polarization voltage)

1.1.2 Connectors

The instrument is equipped with the following connectors:

- **MSB connector (Metrohm Serial Bus)**
  For connecting a stirrer.
- **USB (OTG) connector**
  The 6.2151.100 adapter can be used to connect, for example, a printer, a USB flash drive or a USB keyboard.
- **Electrode connector**
  For connecting polarizable electrodes.
- **Remote connector**
  For connecting instruments with a remote interface.

1.1.3 Intended use

The 870 KF Titrino plus is designed for usage as a titrator in analytical laboratories. Its main application field is volumetric titration.

This instrument is suitable for processing chemicals and flammable samples. The usage of the 870 KF Titrino plus therefore requires that the user have basic knowledge and experience in the handling of toxic and caustic substances. Knowledge with respect to the application of the fire prevention measures prescribed for laboratories is also mandatory.

1.2 About the documentation

CAUTION

Please read through this documentation carefully before putting the instrument into operation. The documentation contains information and warnings which the user must follow in order to ensure safe operation of the instrument.

1.2.1 Symbols and conventions

The following symbols and formatting may appear in this documentation:

*(5-**12**)*	**Cross-reference to figure legend** The first number refers to the figure number, the second to the instrument part in the figure.
1	**Instruction step** Carry out these steps in the sequence shown.
Method	**Dialog text**, **parameter** in the software
File ▶ New	Menu or menu item
[Next]	**Button** or **key**
	**WARNING** This symbol draws attention to a possible life-threatening hazard or risk of injury.
	**WARNING** This symbol draws attention to a possible hazard due to electrical current.
	**WARNING** This symbol draws attention to a possible hazard due to heat or hot instrument parts.
	**WARNING** This symbol draws attention to a possible biological hazard.
	**CAUTION** This symbol draws attention to possible damage to instruments or instrument parts.

NOTE

This symbol highlights additional information and tips.

1.3 Safety instructions

1.3.1 General notes on safety

WARNING

This instrument may only be operated in accordance with the specifications in this documentation.

This instrument has left the factory in a flawless state in terms of technical safety. To maintain this state and ensure non-hazardous operation of the instrument, the following instructions must be observed carefully.

1.3.2 Electrical safety

The electrical safety when working with the instrument is ensured as part of the international standard IEC 61010.

WARNING

Only personnel qualified by Metrohm are authorized to carry out service work on electronic components.

WARNING

Never open the housing of the instrument. The instrument could be damaged by this. There is also a risk of serious injury if live components are touched.

There are no parts inside the housing which can be serviced or replaced by the user.

Mains voltage

WARNING

An incorrect mains voltage can damage the instrument.

Only operate this instrument with a mains voltage specified for it (see rear panel of the instrument).

Protection against electrostatic charges



WARNING

Electronic components are sensitive to electrostatic charges and can be destroyed by discharges.

Do not fail to pull the mains cable out of the mains connection socket before you set up or disconnect electrical plug connections at the rear of the instrument.

1.3.3 Tubing and capillary connections



CAUTION

Leaks in tubing and capillary connections are a safety risk. Tighten all connections well by hand. Avoid applying excessive force to tubing connections. Damaged tubing ends lead to leakage. Appropriate tools can be used to loosen connections.

Check the connections regularly for leakage. If the instrument is used mainly in unattended operation, then weekly inspections are mandatory.

1.3.4 Flammable solvents and chemicals

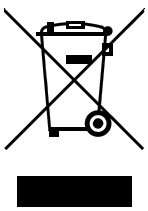


WARNING

All relevant safety measures are to be observed when working with flammable solvents and chemicals.

- Set up the instrument in a well-ventilated location (e.g. fume cupboard).
- Keep all sources of flame far from the workplace.
- Clean up spilled liquids and solids immediately.
- Follow the safety instructions of the chemical manufacturer.

1.3.5 Recycling and disposal



This product is covered by European Directive 2002/96/EC, WEEE – Waste from Electrical and Electronic Equipment.

The correct disposal of your old equipment will help to prevent negative effects on the environment and public health.

More details about the disposal of your old equipment can be obtained from your local authorities, from waste disposal companies or from your local dealer.

2 Overview of the instrument

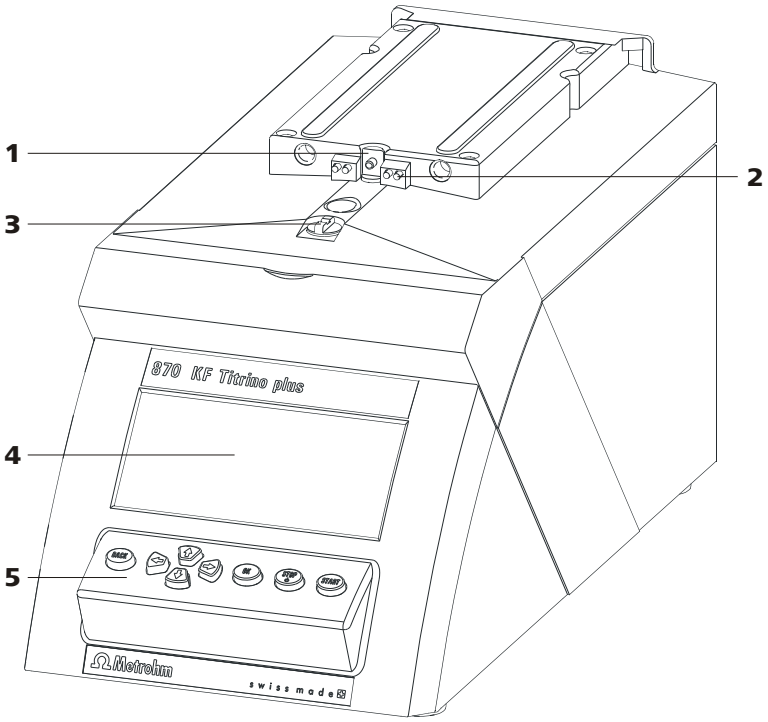


Figure 1 Front 870 KF Titrino plus

1	**Piston rod** Of the dosing drive.	**2**	**Contact pins** For the data chip.
3	**Coupling** For switching the flat stopcock.	**4**	**Display**
5	**Keypad**		

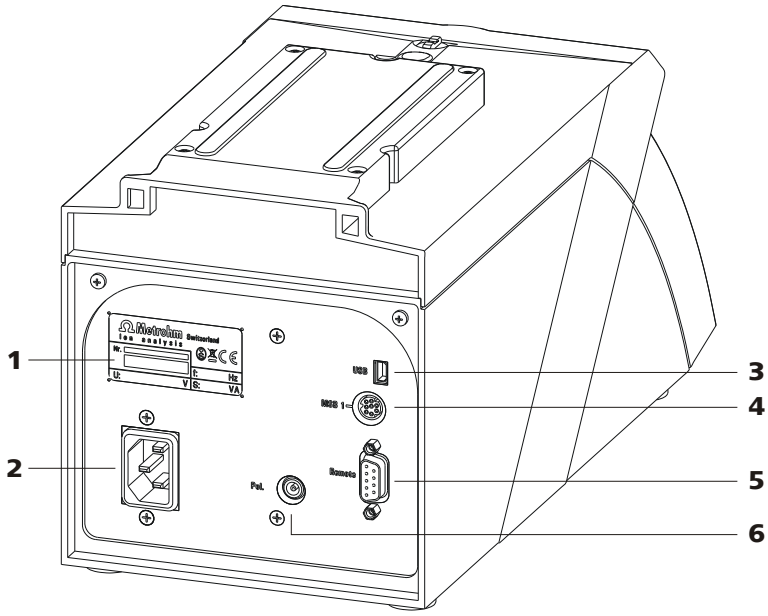


Figure 2 Rear 870 KF Titrino plus

1 **Type plate** Contains specifications concerning mains voltage and serial number.	**2** **Mains connection socket**
3 **USB (OTG) connector** For connecting printers, USB sticks, USB hubs, etc.	**4** **MSB connector** Metrohm Serial Bus. For connecting a stirrer. Mini DIN, 9-pin.
5 **Remote connector** For connecting instruments with a remote interface. D-Sub, 9-pin.	**6** **Electrode connector (Pol.)** For connecting polarizable electrodes, e.g. double Pt electrodes. Socket F.

3 Water determination according to Karl Fischer (KFT)

Karl Fischer Titration is a method for volumetric water determination. Conditioning is carried out automatically both before and after the actual titration. The reagent dosing is controlled in such a way that a predefined endpoint is reached as quickly and as accurately as possible. The volume steps and the rate of reagent dosing are regulated by the difference between the current measured value and the predefined endpoint. This means that titration is performed more slowly in the control range and that smaller volumes are added. The titration is stopped at the endpoint either drift-controlled or after a waiting time. The volume dosed until the endpoint is used to calculate the water content of the sample.

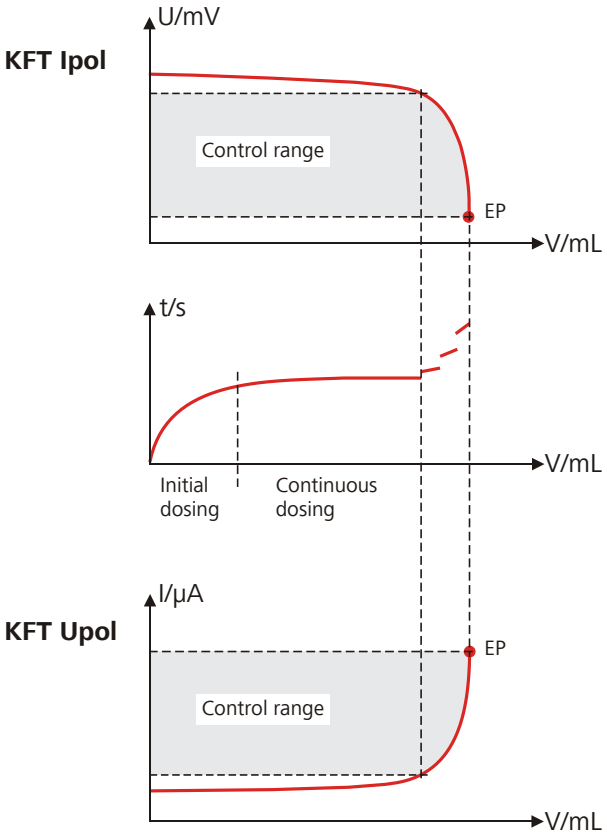


Figure 3 Reagent dosing for KFT

4 Installation

4.1 Setting up the instrument

4.1.1 Packaging

The instrument is supplied in highly protective special packaging together with the separately packed accessories. Keep this packaging, as only this ensures safe transportation of the instrument.

4.1.2 Checks

Immediately after receipt, check whether the shipment has arrived complete and without damage by comparing it with the delivery note.

4.1.3 Location

The instrument has been developed for operation indoors and may not be used in explosive environments.

Place the instrument in a location of the laboratory which is suitable for operation, free of vibrations, protected from corrosive atmosphere, and contamination by chemicals.

The instrument should be protected against excessive temperature fluctuations and direct sunlight.

4.2 Connecting a sensor

Connecting a polarizable electrode

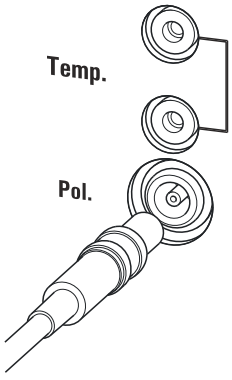


Figure 4 Connecting a polarizable electrode

NOTE

The electrode cable is protected against accidental disconnection of the cable by means of a pull-out protection feature. If you wish to remove the plug, then you must first retract the outer plug sleeve.

4.3 Connecting a stirrer

You can connect the following stirrers:

- 801 Stirrer
- 803 Ti Stand
- 804 Ti Stand (requires rod stirrer)

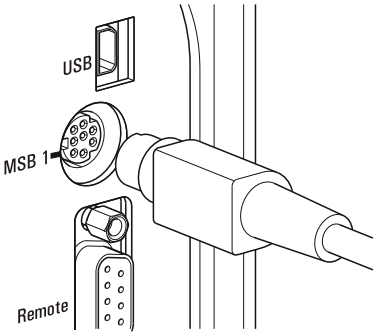


Figure 5 Connecting a stirrer

CAUTION

Make sure that the flat side of the plug matches the marking on the socket.

4.4 Connecting a balance

Balances are equipped with a serial RS-232 interface as a rule. To connect a balance, you require a 6.2148.030 RS-232/USB Box.

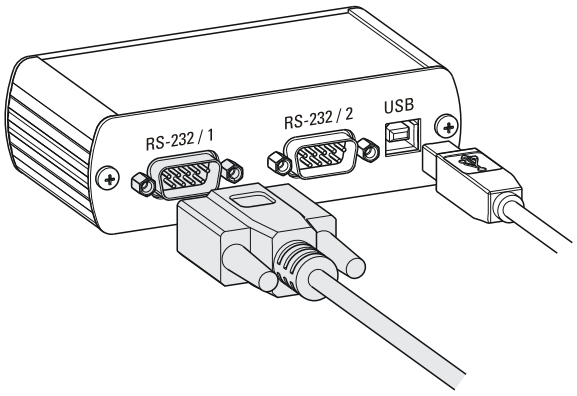


Figure 6 Connecting a balance

When a 6.2151.020 USB cable is used, then the 6.2148.030 RS-232/USB Box can be connected to the 870 KF Titrino plus by means of a USB hub or a 6.2151.100 adapter *(see Chapter 4.5, page 11)*.

Connect the 9-pin plug of the respective balance connecting cable to the **RS 232/1** connector. Consult the user manual of the balance in order to select the correct connecting cable.

The parameters for the RS-232 interface on the instrument must match those on the balance *(see "Editing the COM1 settings", page 47)*. Additionally consult the user manual of the balance.

4.5 Connecting a keyboard, printer and other USB devices

The 870 KF Titrino plus has a USB (OTG) connector. Use the provided 6.2151.100 adapter USB MINI (OTG) - USB A for connecting USB devices as e.g. printers, keyboards or USB sticks, see the following figure.

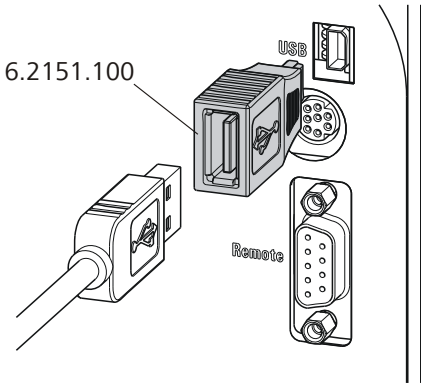


Figure 7 Connecting USB devices

CAUTION

Switch the instrument off before connecting or disconnecting a USB device or a USB stick.

The 870 KF Titrino plus can only recognize the device immediately after switching on.

The following devices can be operated **directly on the USB connector with the 6.2151.100 adapter**:

- USB sticks (for the backup or storing of methods)
- 6.2147.000 numerical USB keypad
- 6.2148.030 RS-232/USB Box (for connecting balances or for the RS-232 remote control)
- USB hub (with or without an own power supply)

The **6.2147.000 numerical USB keypad** serves for comfortable numerical input and for navigating in the dialog. In addition, it provides two USB connectors. Connect additional USB devices to the keypad.

NOTE

Most of the USB devices need a so-called hub in order to work correctly.

A USB hub is a distributor to which several USB devices can be connected. USB hubs are available in specialty stores in a number of different models.

The USB (OTG) connector of the 870 KF Titrino plus has no such hub. The 6.2147.000 numerical USB keypad has a USB hub and two USB connectors.

The following devices can **only be connected to a 6.2147.000 numerical keypad or to a USB hub**:

- Printer (with USB connector, use the 6.2151.020 connecting cable)
- Barcode reader (with USB cable)
- Mouse (PC mouse with USB cable, for navigating in the dialog)

The following devices can **only be connected to a USB hub**:

- PC keyboard (with USB cable, for the comfortable input of letters and numbers)
- Keypad with numerical keypad (with USB cable)

If you wish to connect **several different instruments without own power supply**, then you must possibly use a USB hub with own power supply (*self powered*). The USB (OTG) connector of the 870 KF Titrino plus is not designed for supplying power to several devices with elevated electricity requirements.

Also observe the instructions in *chapter 10.4, page 72*.

Examples:

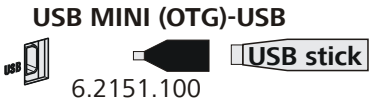


Figure 8 Connecting the USB stick

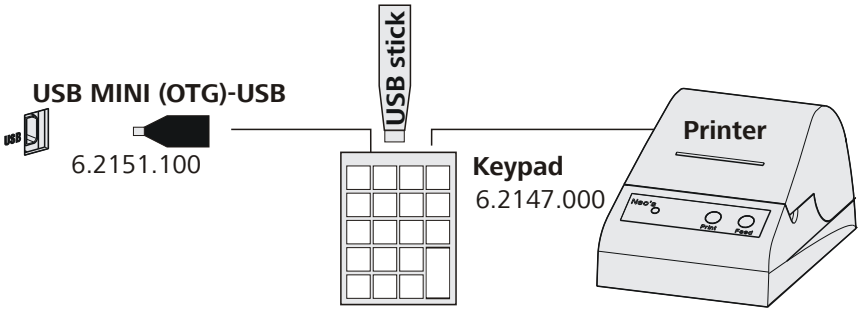


Figure 9 Connecting the 6.2147.000 USB keyboard with USB stick and printer

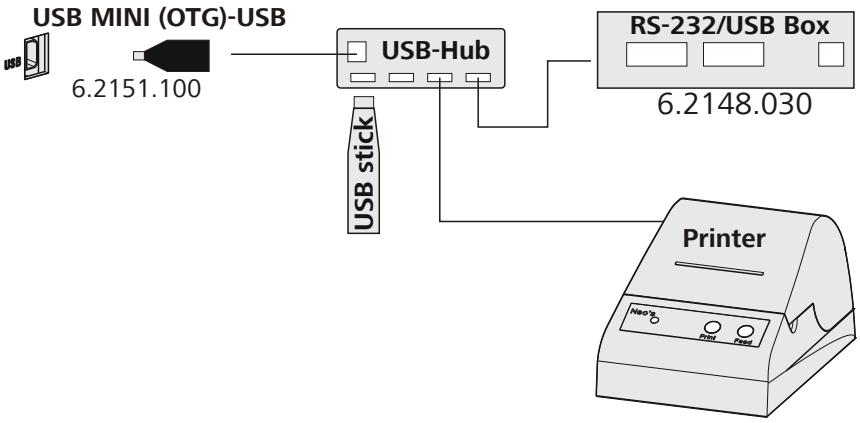


Figure 10 Connecting the USB hub with USB stick, printer and the 6.2148.030 RS-232/USB Box (for connecting balances).

4.6 Connecting instruments to the remote connector

The 870 KF Titrino plus can be integrated in an automation system with the aid of a remote cable.

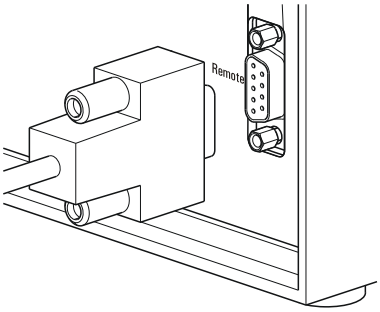


Figure 11 Connecting a remote cable

A variety of different connecting cables are available for connecting Metrohm instruments (e.g. sample changers) *(see Optional Accessories chapter)*.

4.7 Attaching the exchange unit

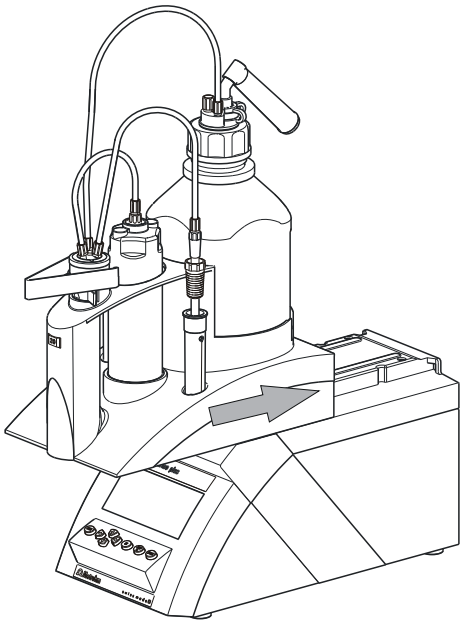


Figure 12 Attaching the exchange unit

To attach the exchange unit, proceed as follows:

1 Slide the exchange unit from the front onto the 870 KF Titrino plus and push all the way to the rear.

It must snap in audibly.

5 Operation

5.1 Switching the instrument on and off

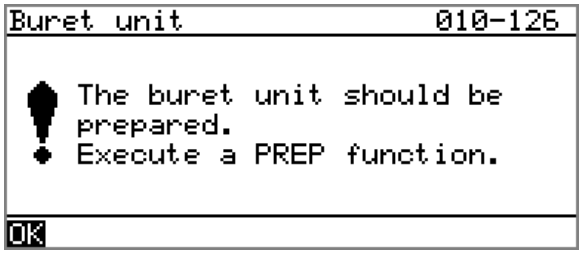
Switching on the instrument

Proceed as follows:



1 ▪ Press the red **[STOP]** key.
The instrument is initialized and a system test performed. This process takes some time.

▪ If a buret unit has been attached, then a request appears to carry out the **PREP** function:



All tubings and the cylinder are rinsed with the **PREP** (Preparing) function. The preparing of the buret unit is described in chapter *"Preparing the buret unit (PREP)", page 33*.

▪ Confirm the message with **[OK]**.
The display of this message can be deactivated in the system settings *(see "PREP warning", page 41)*.

The main dialog is displayed:



Switching off the instrument

The instrument is switched off with the **[STOP]** key. The fact that the key needs to be pressed down for an extended time prevents accidental switch off.

Proceed as follows:

1 ▪ Keep the red **[STOP]** key pressed down for at least 3 s.

A progress bar is displayed. If the key is released during this time, then the instrument will not be switched off.

5.2 Fundamentals of operation

5.2.1 The keypad

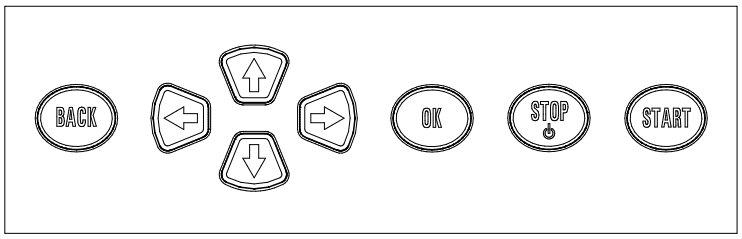
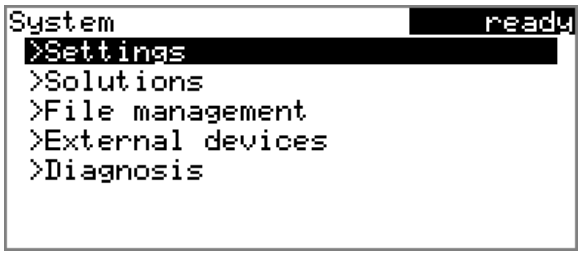


Figure 13 Keypad 870 KF Titrino plus

BACK	Apply the input and exit the dialog.
⇧ ⇩	Move the selection bar either up or down by one line at a time. Select the character to be entered in the text editor.
⇦ ⇨	Select the character to be entered in the text and number editor. Select the individual functions in the function bar.
OK	Confirm the selection.
STOP	Stop an ongoing method run or a manual function. Switch the instrument on or off.
START	Start a method run or a manual function.

5.2.2 Structure of the dialog windows



The current dialog title is displayed on the left-hand side of the title bar. The current status of the system is displayed in the upper right-hand corner:

ready	The instrument is in normal status.
cond.busy	The working medium is being conditioned.
cond.ok	The working medium is conditioned.
busy	A method has been started.

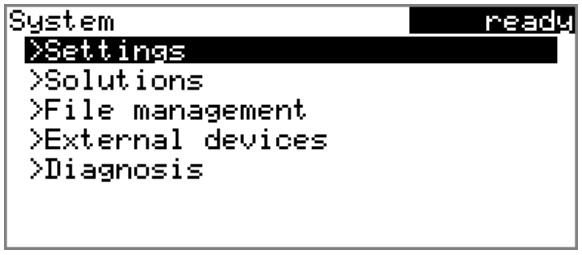
Some dialogs have a so-called function bar on the bottom line. The functions contained therein can be selected with the arrow keys **[⇦]** or **[⇨]** and executed with **[OK]**.



5.2.3 Navigating in the dialog

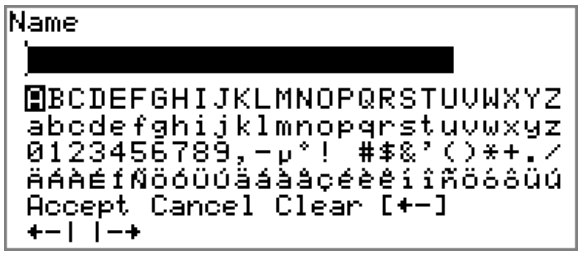
The selection bar is displayed in inverted style. Use the arrow keys **[⇧]** and **[⇩]** to move the selection bar upward or downward one line at a time. If a dialog text is marked with " **>** ", then additional settings are available in a subordinate dialog. Use **[OK]** to access this dialog.

Example: System settings



Use the **[BACK]** key to return to the next higher level.

5.2.4 Entering text and numbers



In the editing dialog for text input or numerical input, select the individual characters with the arrow keys. Use **[OK]** to apply the character in the input field. The following functions are available:

Editing function	Description
Accept	The modification is applied and the editing dialog is exited.
Cancel	The editing dialog is exited without applying the modification.
Clear	The content of the input field is deleted completely.
[+-]	The character left of the cursor is deleted (backspace).
+-|	Text editor only The cursor within the input field is shifted to the left by one character each time that **[OK]** is pressed.
|-+	Text editor only The cursor within the input field is shifted to the right by one character each time that **[OK]** is pressed.
[BACK]	The modification is applied and the editing dialog is exited.

The **[BACK]** key has the same function as **Accept**.

A commercially available USB keyboard can be connected to make it easier to enter text and numbers. The assignment of the keys on the PC keyboard is described in *chapter 10.4.2, page 73*.

5.2.5 Selecting from a selection list



In a selection list, select the individual entries with the arrow keys **[⇧]** and **[⇩]**. Accept the selection with **[OK]** or **[BACK]**.

5.3 Methods

5.3.1 Method templates

The 870 KF Titrino plus contains method templates which are already configured except for a few parameters.

The following method templates can be selected:

KFT Ipol Method with adjustable polarization current.

The blank value is not taken into account for the calculation.

Titer Ipol Titer determination with adjustable polarization current.

Blank Ipol Blank value determination with adjustable polarization current.

KFT Ipol–Blank Method with adjustable polarization current.

The blank value is taken into account for the calculation.

KFT Upol Method with adjustable polarization voltage.

The blank value is not taken into account for the calculation.

Titer Upol Titer determination with adjustable polarization voltage.

Blank Upol Blank value determination with adjustable polarization voltage.

KFT Upol–Blank Method with adjustable polarization voltage.

The blank value is taken into account for the calculation.

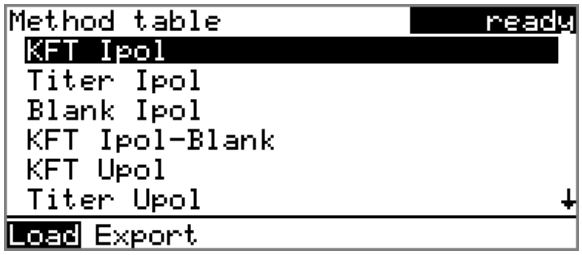
5.3.2 Loading a method

To load a method, proceed as follows:

1 Open the method table

- In the main dialog, select **Method** and press **[OK]**.

The method table with the stored templates opens:



2 Select a method

- Select the desired method.

3 Load the method

- In the function bar, select **Load** and press **[OK]**.

The method is now loaded and is displayed in the main dialog under **Method**.

5.3.3 Saving a method

If the method parameters are changed, then these will be saved automatically. It is not possible to save a method under a different name.

5.3.4 Exporting a method

Methods can be exported to a connected USB stick.

NOTE

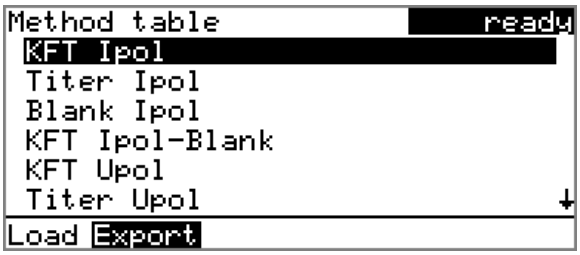
This function is possible only if a USB stick is connected as an external storage medium.

To export a method, proceed as follows:

1 Open the method table

- In the main dialog, select **Method** and press **[OK]**.

The method table with the stored templates opens:



2 Select a method

- Select the desired method.

3 Export the method

- In the function bar, select **Export** and press **[OK]**.

The method is exported. The directory structure on the USB stick is listed in *chapter 6.3, page 44*.

5.4 Sample data

You can enter the sample data (identification, sample size, etc.) in a variety of ways:

- Directly in the main dialog.
- Automatic request immediately after the start of the determination *(see Chapter 5.4.2, page 23)*.

You can also send the sample size and the unit from a connected balance in any case. With some balances, the sample identification and method can be also sent *(see Chapter 10.3, page 71)*.

5.4.1 Entering sample data in the main dialog

For a sample, you can enter the sample data directly in the main dialog, even while the determination is running *(see Chapter 5.6, page 27)*.



ID1

Sample identification.

Entry	**max. 10 characters**
Default value	**empty**

ID2

Sample identification.

Entry	**max. 10 characters**
Default value	**empty**

Sample size

Sample size.

Input range	**–999999999 - 9999999999**
Default value	**1.0**

Unit

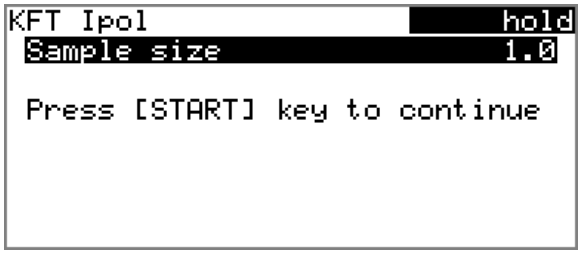
Unit of the sample size.

Selection	**g** | **mg** | **µg** | **mL** | **µL** | **pieces** | **User-defined**
Default value	**g**

User-defined
A user-defined unit can be created. This will be added to the selection list. The previous entry will be overwritten as soon as the new unit has been defined.

5.4.2 Requesting sample data at the start of the determination

The sample data can be requested immediately after the start of the determination in order to ensure that the sample data entry is not forgotten. This automatic request is indispensable when you reweigh your samples.



The corresponding parameters must be activated under **Start conditions** for this purpose. If the parameter **Hold at request** is activated, then the run will be paused and must be continued with **[START]** after the input of the sample data. If **Hold at request** is deactivated, then the titration will be started in the background. This dialog will be displayed until the entering of the sample data is confirmed with **[START]**, even if the the titration is already completed. This ensures that the sample data is available for calculations.

5.5 Carrying out a determination

The sample size can be entered in the following ways when a determination is carried out:

- Enter manually on the instrument.
- Send automatically from a connected balance. For this purpose, check the manual for the balance.

Proceed as follows to carry out a determination:

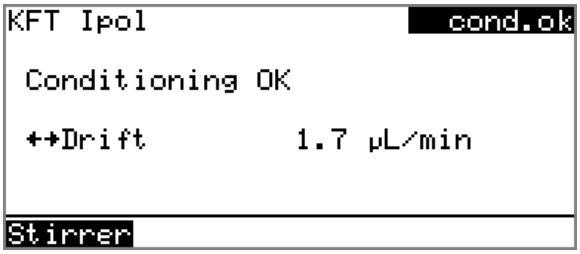
1 Loading the method

- *See Chapter "Loading a method", Page 21.*

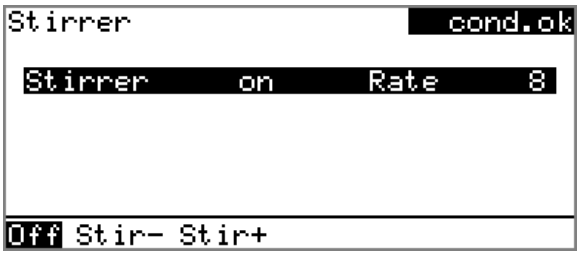
2 Starting conditioning

- Press **[START]**.

Conditioning starts. **Conditioning not OK** is displayed until the endpoint is reached. The working medium is titrated to the endpoint. This is indicated by **Conditioning OK**. The status is kept stable.



The stirring rate can be modified with the **Stirrer** function. The following dialog is opened by pressing **[OK]**:



The stirring rate can be reduced with **Stir-** and increased with **Stir+**. **Off** switches the stirrer off. **On** is now displayed instead. This can be used to switch the stirrer back on. This dialog is exited with **[BACK]**.

3 Adding sample

NOTE

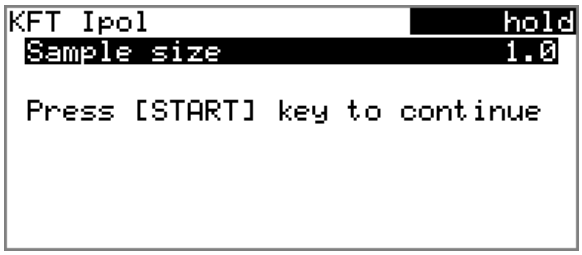
Calculate the amount of the sample in such a way that a titrant consumption of 10…90% of the cylinder volume will result.

- If **Conditioning OK** is displayed, press **[START]**.
  Conditioning is stopped. The request for adding the sample will be displayed for 8 s.
  The sample must be added during this time.



- Add the sample.

Afterward, the request for the sample size appears:



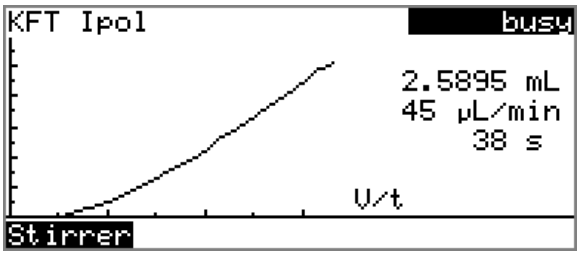
4 Entering the sample size

- Press **[OK]**.
  The editing dialog opens.
- Enter the sample size and apply with **Accept** or **[BACK]**.

5 Starting the titration

- Press **[START]**.

The titration starts and the curve is displayed:



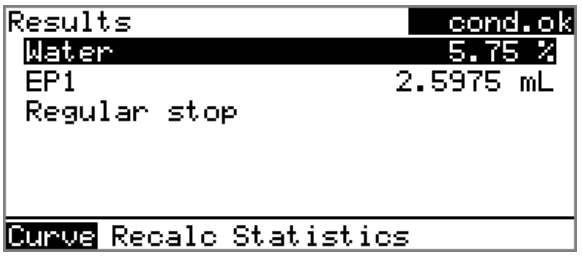
The axes are scaled automatically.

The stirring rate can be modified during titration with the **Stirrer** function. The following dialog is opened by pressing **[OK]**:



The stirring rate can be reduced with **Stir-** and increased with **Stir+**. **Off** switches the stirrer off. **On** is now displayed instead. This can be used to switch the stirrer back on. This dialog is exited with **[BACK]**.

After the completion of the titration, the results dialog is displayed. Conditioning is restarted automatically.



6 Canceling the conditioning

- Press **[STOP]**.

Conditioning is canceled and the dosing cylinder is filled.

Canceling a determination manually

A determination can be canceled at any time with the **[STOP]** key.

5.6 Live modifications

5.6.1 Editing the sample data of the running determination

The sample data can be entered or modified in the main dialog while a determination is running. In calculations always the sample data entered at the end of the titration in the main dialog is used.

Proceed as follows to edit the sample data:

1 Displaying the main dialog

- Press **[BACK]**.

The main dialog is displayed. The determination continues to run in the background.

2 Editing the sample data

- Edit the sample data and apply with **Accept** or **[BACK]**.

3 Displaying the live dialog

- Press **[BACK]**.

or

- Select **Menu** and press **[OK]**.



- Select the menu item **Live dialog** and press **[OK]**.

The live dialog is displayed once again.

NOTE

If the determination is finished while an editing dialog is opened (e.g. of the sample size), then this will be closed automatically and the results dialog will be displayed. The value entered must be entered once more and the determination must be recalculated.

Make sure that the editing dialogs are closed before the determination is finished.

5.6.2 Editing the live parameters

Certain method parameters can be edited while a determination is being carried out. The only parameters that can be modified are those that can be selected. Nevertheless, all of the parameters are visible. The modified parameters are taken into account at once. If you modify, for instance, the start conditions after the start volume has been dosed, then these modifications will not be taken into account until the next determination.

Proceed as follows to edit the parameters:

1 Displaying the main dialog

- Press **[BACK]**.

The main dialog is displayed. The determination continues to run in the background.

2 Opening the main menu

- Select **Menu** and press **[OK]**.



3 Editing the method parameters

- Select the menu item **Parameters** and press **[OK]**.
- Change the desired parameters accordingly.

4 Displaying the live dialog

- Select the menu item **Live dialog** in the main menu and press **[OK]**.

or

- Press **[BACK]** in the main dialog.

The live dialog is displayed once again.

5.7 Results

Menu ▸ Results

After the completion of the titration, the results dialog is displayed:



The calculated result and the endpoint volume are shown in the overview.

Curve

Display the curve of the current determination.

Recalculate

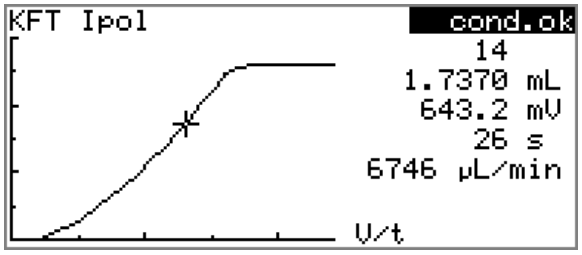
Recalculate the current determination. The procedure will be executed immediately.

Statistics

Display the statistical overview of a determination series *(see Chapter 5.8, page 30)*.

Displaying the curve

The curve of the current determination can be displayed with the **Curve** function.



The arrow keys **[⇦]** and **[⇨]** can be used to move to the individual measuring points. A cross hair is used to show the current position on the curve. The data (volume, measured value, time, etc.) for the respective measuring point is indicated on the right-hand side.

Recalculating

NOTE

Recalculation cannot be undone.

All of the results are recalculated with the **Recalculate** function. This is necessary if, for example, the calculation, the titer or the sample size has been modified.

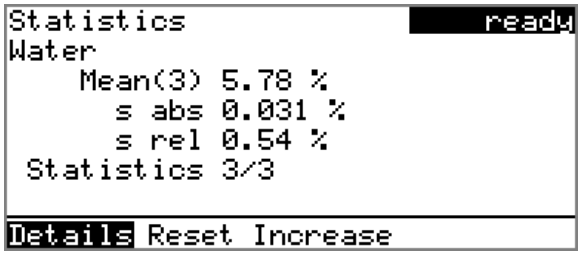
5.8 Statistics

Menu ▸ Results ▸ Statistics

The statistical overview of a determination series can be displayed in the **Results** dialog with the **Statistics** function.

NOTE

This function is visible only if statistics has been activated.



The mean value (**Mean**), the absolute and the relative standard deviation (**s abs** and **s rel**) are displayed in the overview. For the mean value, the number of individual results from which it has been calculated is displayed in parentheses. In this example, it is 3. The **Statistics** line shows how many determinations have already been carried out and how many determinations are to be carried out in total. All three determinations were carried out in this example.

Details

Display additional data.

Reset

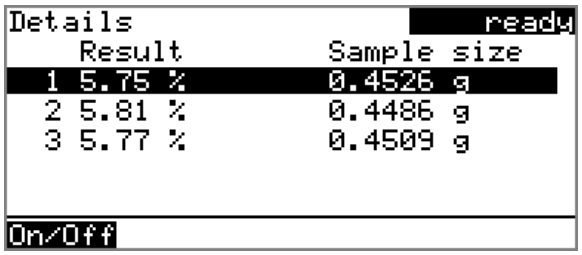
Delete all statistics data.

Increase

Add a further determination to the determination series.

Displaying statistical details

Additional data from the determination series can be displayed with the **Details** function.



The result and the sample size of each determination are shown.

On/Off

Remove the selected determination from the statistics. The line will then be marked with an asterisk (*), the statistics will be recalculated automatically.

Deleting statistical data

All statistical data is deleted with the **Reset** function. The statistics data is deleted automatically in the following cases:

- When all of the determinations of the determination series have been carried out and a new determination has been started afterwards.
- When a new method is loaded.

Adding a determination to a determination series

You can use the function **Increase** to add an additional sample to a determination series, e.g. because a determination was faulty and had to be removed from the statistics. The second number in the **Statistics** line will be increased automatically by one.

5.9 Printing a report manually

Menu ▸ Print reports

Proceed as follows to print a report manually:

1 Opening the main menu

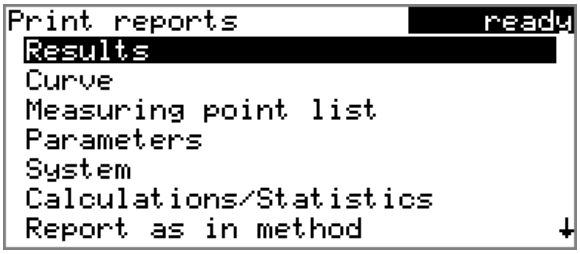
- In the main dialog, select **Menu** and press **[OK]**.



2 Opening the print dialog

- Select the menu item **Print reports** and press **[OK]**.

The dialog window with the available reports opens:



3 Selecting the report

- Select the desired report and press **[OK]**.

The report is printed out.

The following reports can be printed out manually:

Results	Result report with determination properties, sample data, calculated results, etc.
Curve	Curve report. The width of the curve is defined in the system settings *(see "Graphics width", page 46)*.
Measuring point list	Measuring point list report.
Parameters	Report with all method parameters of the loaded method.
System	System report with system settings, solution list, external devices, etc.
Calculations/Statistics	Calculation report. The statistics are also printed out in the case of multiple determinations. The individual determinations with the respective sample size, the mean value, the absolute and the relative standard deviation are printed out for each result.

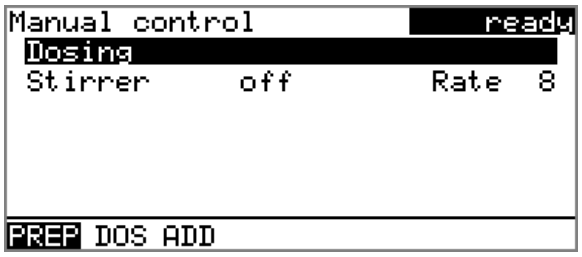
PC/LIMS	Machine-readable report with all of the data for a determination. This report can be saved as a TXT file to a connected USB flash drive or sent to a terminal program or a LIMS via an RS-232 interface. The definition is made in the system settings *(see "PC/LIMS report", page 46)*.
Report as in method	The reports that are defined in the method will be printed out.

5.10 Manual control

Menu ▸ Manual control

The following functions are available in the manual control:

- Dosing
- Stirring



The available subfunctions are listed for each function in the function bar.

NOTE

The **Stirrer** function can only be selected if a stirrer is connected.

5.10.1 Dosing

The following dosing functions are available in the manual control:

Prepare the buret unit (PREP)	Rinse the cylinder and tubings of the buret unit *(see Chapter 10.1.2, page 70)*.
Continuous dosing (DOS)	Dose while the **[START]** key is pressed.
Dose a fixed volume (ADD)	Dose a specified volume.

Preparing the buret unit (PREP)

The **PREP** function is used to rinse the cylinder and tubings of the buret unit and fill them air bubble-free. You should carry out this function before the first determination or once per day.

Proceed as follows:

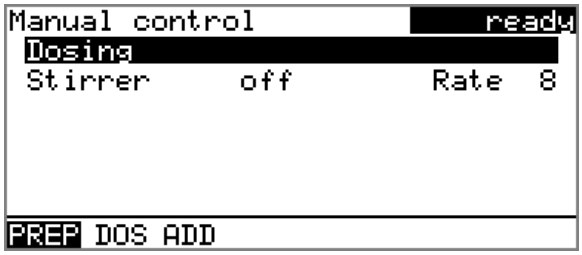
1 Open the manual control

- In the main dialog, select **Menu** and press **[OK]**.
  The main menu opens.
- Select the menu item **Manual control** and press **[OK]**.

Manual control opens.

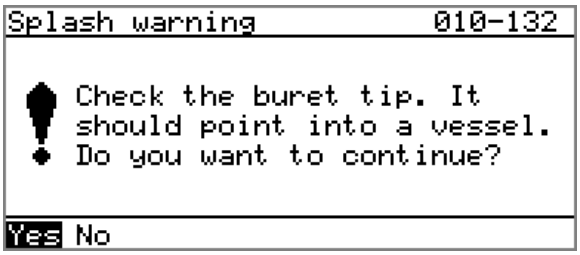
2 Select the dosing function

- Select the **Dosing** item.



- In the function bar, select **PREP** and press **[OK]**.

The following message is displayed:



3 Start the preparing

CAUTION

Make sure that the buret tip is directed into a vessel that can accommodate the cylinder volume of your buret unit several times over.

- Select **Yes** and confirm the message with **[OK]**.

Preparing is carried out.

Continuous dosing (DOS)

Continuous dosing will be carried out with the **DOS** function for as long as you keep the **[START]** key pressed down.

Proceed as follows:

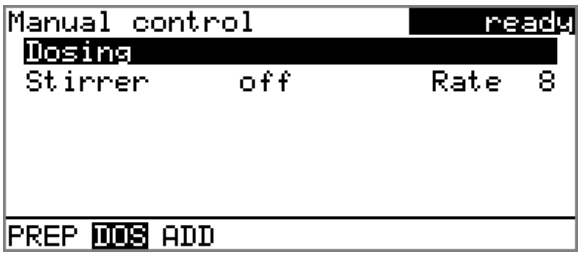
1 Open the manual control

- In the main dialog, select **Menu** and press **[OK]**.
  The main menu opens.
- Select the menu item **Manual control** and press **[OK]**.

Manual control opens.

2 Select the dosing function

- Select the **Dosing** item.



- In the function bar, select **DOS** and press **[OK]**.



3 Configure the dosing function

NOTE

- The dosing and filling rates should be decreased for viscous liquids.
- The maximum dosing and filling rates depend on the cylinder volume *(see Chapter 10.1.1, page 70)*.

- Enter the dosing rate.
- Enter the filling rate.

4 Start dosing

- Press **[START]**.

The status changes to **busy**, the dosed volume is displayed. When the volume of one cylinder has been dosed, the dosing cylinder will be refilled automatically.

5 Fill the cylinder

- Press **[STOP]** or **[BACK]**.

The dosing cylinder is filled. If you start the filling with **[BACK]**, then the dialog will also be exited.

Dosing a particular volume (ADD)

You can dose a particular volume with the **ADD** function.

Proceed as follows:

1 Open the manual control

- In the main dialog, select **Menu** and press **[OK]**.
  The main menu opens.
- Select the menu item **Manual control** and press **[OK]**.

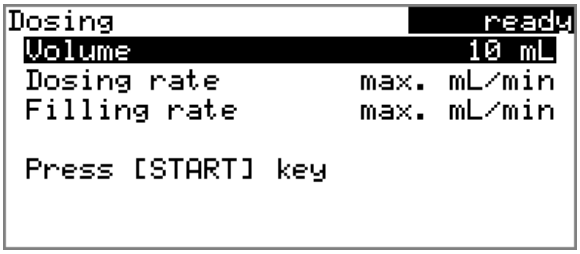
Manual control opens.

2 Select the dosing function

- Select the **Dosing** item.



- In the function bar, select **ADD** and press **[OK]**.



3 Configure the dosing function

NOTE

- The dosing and filling rates should be decreased for viscous liquids.
- The maximum dosing and filling rates depend on the cylinder volume *(see Chapter 10.1.1, page 70)*.

- Enter the desired volume.
- Enter the dosing rate.
- Enter the filling rate.

4 Start dosing

- Press **[START]**.

The status changes to **busy**, the dosed volume is displayed. When the volume of one cylinder has been dosed, the dosing cylinder will be refilled automatically.

5 Fill the cylinder

- Press **[STOP]** or **[BACK]**.

The dosing cylinder is filled. If you start the filling with **[BACK]**, then the dialog will also be exited.

5.10.2 Stirring

You can control a connected stirrer manually.

Proceed as follows:

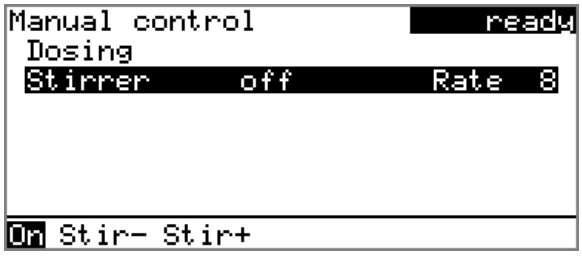
1 Opening the manual control

- In the main dialog, select **Menu** and press **[OK]**.
  The main menu opens.
- Select the menu item **Manual control** and press **[OK]**.

Manual control opens.

2 Setting the stirring rate

- Select the **Stirrer** item.



- In the function bar, select **Stir-** or **Stir+**.
  The stirring rate will be increased or decreased by one step each time the **[OK]** key is pressed.
  The algebraic sign changes the direction in which the stirring is done. When viewing the stirrer from above, this means:
  - "+": counterclockwise rotation
  - "–": clockwise rotation

3 Switching on the stirrer

- In the function bar, select **On** and press **[OK]**.

The stirrer is started and stirs at the rate which has been set. **Off** is now displayed in the function bar.

4 Switching off the stirrer

- In the function bar, select **Off** and confirm with **[OK]**.

The stirrer is stopped.

6 System settings

6.1 Basic settings

Menu ▸ System ▸ Settings

This chapter contains a description of general instrument settings.

User name

A user name can be entered here for the report. This parameter will only be printed if a user has been defined.

Entry	**max. 12 characters**
Default value	**empty**

Instrument name

A instrument name can be entered here for the report. This parameter will only be printed if a designation has been defined.

Entry	**max. 10 characters**
Default value	**empty**

Serial number

Serial number of the instrument. This is printed as a part of the instrument identification in the report header.

Program version

Version number of the instrument software. This is printed as a part of the instrument identification in the report header.

Time

Current time. Only valid numbers can be entered.

Format: hh:mm:ss

Date

Current date. Only valid numbers can be entered.

Format: YYYY:MM:DD

Language

Setting the dialog language. An additional language can be selected besides English.

NOTE

In order to ensure that a second language can be selected, it must first be installed. This installation must be carried out by specialist personnel. In chapter *Language files, page 49*, you will find details regarding the installation of a second language.

Dialog type

The user dialog can be limited for routine operations. One can operate normally with methods in the limited dialog. However, no settings can be made or methods deleted.

The resetting of the dialog will take effect as soon as you exit the main menu.

The limitation of the dialog results in the following:

- The menu items **System** and **Parameters** are not shown in the main menu.
- Methods can only be loaded, but not deleted, exported or created.

NOTE

If the limited dialog for routine operation is activated, then the expert dialog cannot be activated during ongoing operation. To change the dialog type, the 870 KF Titrino plus must be switched off and then back on again. The expert dialog can be forced as soon as the instrument is started up again. Then it is possible to enter whatever settings one wishes, e.g. the changing of the dialog type. If the instrument is switched off again without changing the dialog type, then the routine dialog will remain activated.

Forcing the expert dialog:

- Switch on the instrument.
- Wait for the display of the instrument logo with the lettering **easy, safe, precise**.
- Press the **[STOP]** key once again and hold it down while also briefly pressing the **[BACK]** key.
- Release both keys once again.

Selection	**Expert** | **Routine**
Default value	**Expert**

Expert
Complete dialog.

Routine
Limited dialog for routine operations.

Contrast

The contrast of the display can be adjusted with the arrow keys **[⇦]** and **[⇨]**.

- **[⇦]**: the contrast will be decreased by one step each time the key is pressed.
- **[⇨]**: the contrast will be increased by one step each time the key is pressed.

Input range	**150 - 240**
Default value	**212**

NOTE

Alternatively, the contrast can also be modified in the following manner:

Keep the red **[STOP]** key pressed down. As soon as the progress bar appears, also press the arrow key **[⇩]** or **[⇧]** repeatedly.

This method will, however, cause the contrast to be modified by several steps.

Beep

If this parameter is activated, then a short beep will sound in the following cases:

- When a key is pressed.
- At the end of the determination.
- When the system remains conditioned without interruption for 10 seconds.

Selection	**on** | **off**
Default value	**on**

PREP warning

If this parameter is activated, then the recommendation will be made to carry out the function **PREP** (Preparing):

- After the instrument is switched on.
- Each time a buret unit is attached.

All tubing and the cylinder are rinsed with this function *(see Chapter 10.1.2, page 70)*.

Selection	**on** | **off**
Default value	**on**

6.2 Managing solutions

6.2.1 General

Menu ▸ System ▸ Solutions

Solutions can be used in intelligent buret units or in non-intelligent buret units. Intelligent buret units have a built-in data chip on which the data for the reagent is stored. This data is automatically read out during attachment and entered in the solution list.



The name and the type are specified for each solution in the solution list. The asterisk (*****) on the right-hand side indicates that this buret unit is attached (only for intelligent buret units). An unlimited number of solutions in buret units with data chip can be added to the solution list. The number of solutions in buret units without data chip is limited to 10 items.

Meaning of the type:

- **EU**: exchange unit without data chip
- **IEU**: exchange unit with integrated data chip

not defined is the standard solution. It can be used to carry out determinations without having configured a solution. If you carry out a titer determination with the titration parameter **Solution** = **not defined**, then the result will be saved as titer of this solution. If you carry out a titration with the titration parameter **Solution** = **not defined**, then the data of this solution will be used for the calculation. The titer and the concentration can be edited, but this standard solution can neither be renamed nor deleted.

Edit

Edit the data of the selected solution, see following chapter.

New

Add a new solution to the list, see following chapter.

Delete

Delete the selected solution from the list.

6.2.2 Editing the solution data

Name

The designation of the solution is used for unambiguous identification.

Entry	**max. 24 characters**
Default value	**empty**

Type

The model of the buret unit is displayed.

Cylinder volume

Cylinder volume of the buret unit in mL. The cylinder volume is automatically read out with intelligent buret units.

Selection	**1** | **5** | **10** | **20** | **50**
Default value	**20**

Concentration

Concentration of the solution.

Input range	**–999999999 - 9999999999**
Default value	**1.000**

Concentration unit

Unit of the concentration.

Selection	**µmol/mL** | **mmol/L** | **mol/L** | **g/L** | **mg/L** | **mg/mL** | **µg/L** | **ppm** | **%** | **mEq/L** | **User-defined**
Default value	**mol/L**

User-defined
A user-defined unit can be created. This will be added to the selection list. The previous entry will be overwritten as soon as the new unit has been defined. A blank entry can be generated this way as well.

Titer

Titer of the solution.

Input range	**–999999999 - 9999999999**
Default value	**1.000**

Titer unit

Unit of the titer.

Selection	**µmol/mL** | **mmol/L** | **mol/L** | **g/L** | **mg/L** | **mg/mL** | **µg/L** | **ppm** | **%** | **mEq/L** | **empty** | **User-defined**
Default value	**empty**

User-defined
A user-defined unit can be created. This will be added to the selection list. The previous entry will be overwritten as soon as the new unit has been defined. A blank entry can be generated this way as well.

Date titer det.

Date of the last titer determination.

Monitoring

Activating and deactivating the titer monitoring.

Selection	**on** | **off**
Default value	**off**

Time interval

This parameter is visible only when **Monitoring** = **on**.

You will be notified that this time interval (in days) has elapsed when starting a method. You can then select whether or not you would still like to start the method.

Input range	**1 - 999 d**
Default value	**999 d**

6.3 File management

Menu ▸ System ▸ File management

NOTE

This menu item is visible only if a USB flash drive has been connected as an external storage medium.

Methods can be imported and deleted from a USB flash drive in this dialog. Only methods located in the **Files** directory are displayed in the list *(see "Directory structure on the USB flash drive", page 45)*.

A backup of the system can be created (all data and settings). Similarly, an existing backup can be reloaded.

Import

Import the selected method.

Delete

Delete the selected method.

Backup

Create a backup of all data and settings on the USB flash drive.

NOTE

Only **one** backup can be created on the same USB flash drive.

If a backup is already stored on the flash drive, then this will be overwritten as soon as the function is performed once again.

Restore

Load the backup from a connected USB flash drive.

Directory structure on the USB flash drive

A directory with the instrument number will be created on the USB flash drive. The structure within this directory appears as follows:

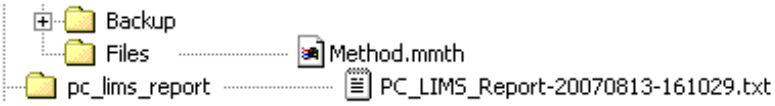


Figure 14 Directory structure on the USB flash drive

Backup — All of the files of the backup are stored in this directory. The directory is created as soon as a backup is created for the first time.

Files — Exported methods are stored in this directory. The directory is created as soon as a backup is exported for the first time.

Only methods located in this directory can be imported.

pc_lims_report — PC/LIMS reports are stored in this directory as TXT files. The directory is created as soon as a PC/LIMS report is printed for the first time.

6.4 Configuring external devices

Menu ▸ System ▸ External devices

PC/LIMS report

Specification of the storage location for the PC/LIMS report. The PC/LIMS report is a machine-readable report with all of the important data for a determination. It can be saved as follows:

- as a TXT file on a USB flash drive.
- to a LIMS via an RS-232 interface. The 6.2148.030 RS-232/USB Box is required for this purpose.

Selection	**COM2** | **USB Stick**
Default value	**USB Stick**

COM2
The report is sent via the serial COM2 interface. The interface parameters set in the dialog **COM2 settings** are used *(see "Editing the COM2 settings", page 48)*.

USB Stick
The report will be saved as a TXT file on the USB flash drive in the folder **pc_lims_report**.

Printer

If a printer is connected, then the printer type needs to be defined here in order for the reports to be printed out correctly.

The printers that have the designation **ESC-POS** are so-called POS printers (point-of-sale printers), i.e. they print on continuous paper.

Selection	**Citizen (ESC-POS)** | **Custom (ESC-POS)** | **Epson** | **Epson (ESC-POS)** | **HP DeskJet** | **HP LaserJet** | **Seiko (ESC-POS)**
Default value	**HP DeskJet**

Graphics width

Adjust the width of the curve to be printed out to the paper width of the printer to be used. The default value depends on the selected printer. The height of the curve is 2/3 of the width.

Input range	**100 - 3000 Pixels**

Keyboard layout

A commercially available USB keyboard can be connected to make it easier to enter text and numbers. Specify the country-specific keyboard layout.

Selection	**English US** | **French FR** | **German CH** | **German DE** | **Spanish ES**
Default value	**English US**

Balance

If you have connected a balance, then you must define the balance type here.

Selection	**AND** | **Mettler** | **Mettler AT** | **Mettler AX** | **Ohaus** | **Precisa** | **Sartorius** | **Shimadzu**
Default value	**Sartorius**

The following table indicates the balance type that needs to be selected for the balance model:

Balance	Balance type
AND	**AND**
Mettler AB, AE, AG, AM, AJ, PE, PM, PJ, PR, XP, XS	**Mettler**
Mettler AT	**Mettler AT**
Mettler AX, MX, UMX, PG, AB-S, PB-S	**Mettler AX**
Ohaus Voyager, Explorer, Analytical Plus	**Ohaus**
Precisa	**Precisa**
Sartorius	**Sartorius**
Shimadzu BX, BW	**Shimadzu**

Editing the COM1 settings

Menu ▸ System ▸ External devices ▸ COM1 settings

The interface parameters for the connected balance are set under **COM1 settings**.

Baud rate

Transfer rate in characters per second.

Selection	**1200** | **2400** | **4800** | **9600** | **19200** | **38400** | **57600** | **115200**
Default value	**9600**

Data bits

Number of data bits.

Selection	**7** | **8**
Default value	**8**

Stop bits

Number of stop bits.

Selection	**1** | **2**
Default value	**1**

Parity

Type of parity testing.

Selection	**even** | **none** | **odd**
Default value	**none**

Handshake

Type of the data transfer protocol.

Selection	**hardware** | **software** | **none**
Default value	**hardware**

NOTE

If communications problems occur, set the parameter **Handshake** to **software**, and make another attempt.

Editing the COM2 settings

Menu ▸ System ▸ External devices ▸ COM2 settings

The interface parameters for instruments connected to the **RS-232/2** connector of the RS-232/USB Box (e.g. PC) are set under **COM2 settings**. The parameters and input ranges are identical to those for the COM1 interface.

6.5 Instrument diagnosis

6.5.1 Loading program versions and language files

Menu ▸ System ▸ Diagnosis

New program versions or language files can be loaded from a USB flash drive. The corresponding file must be saved on the USB flash drive in a directory with the instrument number (e.g. 848 or 863).

You can distinguish between language files and program files by noting how the file name is constructed.

Program files

They are instrument-specific. The file name has the following structure:

5XXXyyyy.bin where

XXX = Instrument type (e.g. 848 for the 848 Titrino plus)

yyyy = Program version

Language files

They can be recognized by means of the two-digit language code in the file name. A language file contains the dialog texts for various instrument types. It is not instrument-specific. The file name has the following structure:

5848xxxxYY.bin where

xxxx = Version number

YY = Language, e.g. DE (German), FR (French), ES (Spanish)

Loading a file

Proceed as follows:

1 Connecting the USB flash drive

- Plug in the USB flash drive with the 6.2151.100 adapter (USB MINI (OTG) - USB A) at the instrument's USB port.
- Switch on the instrument.

2 Opening the update dialog

- Under **Menu ▸ System ▸ Diagnosis**, select the menu item **Software update**.
- Press **[OK]**.



3 Opening the file selection

- Press **[OK]**.

The selection list with the program and language files present on the USB flash drive opens.

4 Selecting the file

- Use the arrow keys to select the required file.
- Press **[OK]**.

5 Starting the update

- Press **[START]**.

The update process is started, it runs automatically. At the end of the process, the instrument will be switched off automatically and switched back on again. No user intervention is required.

6.5.2 Diagnosis functions

Electronic and mechanical functional groups in Metrohm instruments can and should be checked as part of regular maintenance by specialist personnel from Metrohm. Please ask your local Metrohm representative regarding the precise terms and conditions involved in concluding a corresponding maintenance agreement.

7 Parameters

7.1 Karl Fischer Titrations (KFT)

7.1.1 Conditioning

Menu ▸ Parameters ▸ Conditioning

Under **Conditioning**, the conditions required for conditioning are defined.

Conditioning

If this parameter is switched on, then the first time the titration is started the working medium will be titrated to the endpoint with the specified control parameters. The status is kept stable. The actual method run does not begin until **[START]** has been pressed once more. Conditioning will be carried out again automatically after the titration.

Selection	**on** | **off**
Default value	**on**

Start drift

Conditioning OK will be displayed as soon as this volume drift has been reached and the titration can be started.

Input range	**1 - 999 µL/min**
Default value	**20 µL/min**

Drift correction

The endpoint volume can be corrected by taking the drift value into account. For this, the volume drift is multiplied with the drift correction time and this value is then subtracted from the endpoint volume. The drift correction time is the time interval between the end of conditioning and the end of the determination.

Selection	**auto** | **manual** | **off**
Default value	**off**

auto
The value of the current volume drift is applied automatically at the start of the titration.

manual
If the volume drift is known throughout a prolonged period of time, then this can be entered manually.

off
No drift correction takes place.

Drift value

This parameter is visible only when **Drift correction** = **manual**.

Volume drift for manual drift correction.

Input range	**0.0 - 99.9 µL/min**
Default value	**0.0 µL/min**

Cond. stop volume

Maximum permissible volume that can be dosed during conditioning. Conditioning is stopped when the specified volume is dosed. If conditioning is continued by pressing **[START]** once again, then the titrant volume that has already been dosed will not be taken into account; i.e. the dosing starts again at zero. The stop volume should be adjusted to the size of the titration cell in order to prevent any overflow.

Input range	**0.00000 - 9999.99 mL**
Default value	**20.0000 mL**
Selection	**off**

Cond. stop time

Maximum permissible time over which conditioning may take place. Conditioning is stopped when the specified time has elapsed.

Input range	**0 - 999999 s**
Selection	**off**
Default value	**off**

7.1.2 Start conditions

Menu ▶ Parameters ▶ Start conditions

The parameters that are carried out before the start of titration are defined under **Start conditions**.

Start volume

Volume that is dosed prior to the start of the titration.

Input range	**0.00000 - 9999.99 mL**
Default value	**0.00000 mL**

Dosing rate

Rate at which the start volume is dosed. The maximum dosing rate depends on the cylinder volume *(see Chapter 10.1.1, page 70)*.

Input range	**0.01 - 166.00 mL/min**
Selection	**max.**
Default value	**max.**

Pause

Waiting time, e.g. in case of a slow response of the electrode after the start or reaction time after the dosing of a start volume.

Input range	**0 - 999999 s**
Default value	**0 s**

Request sample ID

Selection of the sample identification that is queried in the method run.

Selection	**off** | **ID1** | **ID2** | **ID1&ID2**
Default value	**off**

Request sample size

If this parameter is switched on, then the value for the sample size will be queried.

Selection	**on** | **off**
Default value	**on** For the methods "Blank Ipol" and "Blank Upol" the default value is **off**.

Request sample unit

If this parameter is switched on, then the unit for the sample size will be queried.

Selection	**on** | **off**
Default value	**off**

Hold at request

If this parameter is switched on, then the method run will be paused during the query. If the parameter is switched off, the titration will be started in the background.

Selection	**on** | **off**
Default value	**on**

7.1.3 Control parameters

Menu ▸ Parameters ▸ Control parameters

Under **Control parameters**, the control parameters for the endpoint are defined.

Endpoint at

Measured value for the endpoint.

Measuring mode Ipol:

Input range	**–1250.0 - 1250.0 mV**
Default value	**250.0 mV**
Selection	**off**

Measuring mode Upol:

Input range	**–125.00 - 125.00 µA**
Default value	**25.00 µA**
Selection	**off**

Titration rate

Three predefined sets of parameters can be selected for the titration rate.

Selection	**slow** | **optimal** | **fast** | **user**
Default value	**optimal**

slow
For samples with a low water content or samples which release their moisture only slowly.

optimal
For all standard titrations. The parameters have been optimized for the most frequent applications.

fast
For uncritical samples with high water content.

user
The individual titration parameters can be modified.

The settings of the individual titration rates are listed in *table 1, page 55*.

Dynamics

This parameter is visible only when **Titration rate** = **user**.

This parameter defines the control range before the specified endpoint. Individual volume steps are dosed in the control range, the dosing is finely controlled. The closer the endpoint, the slower the dosing until the volume increment defined under **Min. increment** has been reached. The larger the control range, the slower the titration. Outside the control range, dosing is carried out continuously, and the dosing rate is defined under **Max. rate**.

Measuring mode Ipol:

Input range	**0.1 - 1250.0 mV**
Default value	**100.0 mV**
Selection	**off**

Measuring mode Upol:

Input range	**0.01 - 125.00 µA**
Default value	**10.00 µA**
Selection	**off**

Max. rate

This parameter is visible only when **Titration rate** = **user**.

Rate at which dosing is carried out outside of the control range. The maximum dosing rate depends on the cylinder volume *(see Chapter 10.1.1, page 70)* .

Input range	**0.01 - 166.00 mL/min**
Selection	**max.**
Default value	**max.**

Min. increment

This parameter is visible only when **Titration rate** = **user**.

Minimum volume increment that is dosed at the beginning of the titration and in the control range at the end of the titration. This parameter has a decisive influence on the titration rate and thus also on the accuracy. The smaller the selected minimum increment, the slower the titration.

Input range	**0.1 - 99.90 µL**
Selection	**min.**
Default value	**min.**

Table 1 Default values of the predefined titration rates for KFT

	Titration rate		
	slow	**optimal**	**fast**
Dynamics			
– Ipol	300.0 mV	100.0 mV	30.0 mV
– Upol	40.00 µA	10.00 µA	5.00 µA
Max. rate	1.00 mL/min	maximum	maximum
Min. increment	minimum (= cylinder volume/10000)	minimum (= cylinder volume/10000)	5.00 µL

Stop criterion

The titration is stopped when the endpoint has been reached and this stop criterion has been fulfilled. If no stop criterion has been selected then the titration will not be stopped. The stop conditions *(see Chapter 7.1.5, page 58)* always lead to a stop, even if the stop criterion has not been reached.

Selection	**drift** | **time** | **rel. drift** | **off**
Default value	**drift**

drift
The titration is stopped when the stop drift has been reached.

time
The titration is stopped when the endpoint has been exceeded during a certain period of time (**Delay time**).

rel. drift
The titration is stopped when the sum of the drift at the start of the titration and the relative stop drift has been reached.

off
The titration will not be stopped until the stop conditions have been fulfilled.

Stop drift

This parameter is visible only when **Stop criterion** = **drift**.

Titration is stopped when the endpoint and the stop drift have been reached.

Input range	**1 - 999 µL/min**
Default value	**20 µL/min**

Delay time

This parameter is visible only when **Stop criterion** = **time**.

When the endpoint is reached, the specified time is allowed to elapse after the last dosing and the titration is then stopped.

Input range	**0 - 999 s**
Default value	**10 s**

Relative stop drift

This parameter is visible only when **Stop criterion** = **rel. drift**.

The titration is stopped when the endpoint and the sum of the drift at the start of the titration and the relative stop drift have been reached.

Input range	**1 - 999 µL/min**
Default value	**10 µL/min**

7.1.4 Titration parameters

Menu ▸ Parameters ▸ Titration parameters

Under **Titration parameters**, the parameters influencing the sequence of the entire titration are defined.

Solution

Selection of the solution from the solution list. We recommend always selecting the solution. This ensures that the correct data (titer, concentration, etc.) is always used for the calculation. Solutions are defined under **System ▸ Solutions**.

For buret units with integrated data chip, a check is made in the method run to verify whether the correct solution has been attached and whether the type of dosing drive matches. For buret units without integrated data chip, the cylinder volume and the type of dosing drive are checked. The validity of the titer is checked for the selected solution at the start of the determination.

Selection	**Selection of configured solution** | **not defined**
Default value	**not defined**

not defined
No check takes place.

I(pol)

The polarization current is the current that is applied to a polarizable electrode during the voltametric measurement. This parameter is available only with I(pol) determinations.

Input range	**–125 - 125 µA** (Increment: **1**)
Default value	**50 µA**

U(pol)

The polarization voltage is the voltage applied to the polarizable electrode during an amperometric measurement. This parameter is available only with U(pol) determinations.

Input range	**–1250 - 1250 mV** (Increment: **10**)
Default value	**400 mV**

Electrode test

For polarizable electrodes, an electrode test can be carried out. A check is made that the electrode is properly connected and that no short-circuit is present. The electrode test is carried out when the determination is started. This parameter is available only with I(pol) and U(pol) determinations.

Selection	**on** | **off**
Default value	**off**

Stirrer

When this parameter is switched on, then the stirrer is switched on at the start of the determination.

Selection	**on** | **off**
Default value	**on**

Stirring rate

Setting the stirring rate. It can be set in steps of –15 to +15. The default setting **8** corresponds to 1000 U/min. The formula for calculating the rotational speed is specified in *chapter 10.2, page 71*. The optimum stirring rate can be tested in the manual control.

The algebraic sign of the stirring rate changes the direction in which the stirring is done. When the stirrer is viewed from above, this means:

- "+": counterclockwise rotation
- "–": clockwise rotation

Input range	**–15 - 15**
Default value	**8**

Temperature

Manually entered titration temperature.

Input range	**–20.0 - 150.0 °C**
Default value	**25.0 °C**

Extraction time

Minimum duration of the titration. The titration will not be stopped during the extraction time, even if the endpoint has already been reached. The titration is however stopped if a stop condition is fulfilled during this time *(see Chapter 7.1.5, page 58)*. The entering of an extraction time is e.g. recommended with samples that release water slowly or if a Karl Fischer oven is used.

Input range	**0 - 999999 s**
Default value	**0 s**

7.1.5 Stop conditions

Menu ▸ Parameters ▸ Stop conditions

Under **Stop conditions**, the conditions for stopping a titration are defined, if this does not occur automatically. This could be the case when the endpoint set is not reached or if the stop criterion *(see "Stop criterion", page 55*) is not fulfilled.

Stop volume

The titration is stopped when the specified volume has been dosed since the start of the titration. This volume should be adjusted to the size of the titration vessel in order to prevent the contents from running over.

Input range	**0.00000 - 9999.99 mL**
Default value	**100.000 mL**
Selection	**off**

Stop time

The titration is stopped when the specified time has elapsed following the termination of the start conditions.

Input range	**0 - 999999 s**
Selection	**off**
Default value	**off**

Filling rate

Rate at which the dosing cylinder is filled after the titration. The maximum filling rate depends on the cylinder volume *(see Chapter 10.1.1, page 70)*.

Input range	**0.01 - 166.00 mL/min**
Selection	**max.**
Default value	**max.**

7.1.6 Calculations - Methods "Blank Ipol/Upol"

Menu ▸ Parameters ▸ Calculation

Calculation formula

EP1*FCT

The calculation formula is predefined and cannot be edited.

The calculated result is saved as a variable **Blank CV01** or **Blank CV02** for each measuring mode separately *(see page 62)*.

Factor (FCT)

If a larger amount of solvent is used for determining the blank value than is later used for the sample, then this factor must be used to convert the endpoint volume accordingly.

Input range	**–999999999 - 9999999999**
Default value	**1.0**

Decimal places

Number of decimal places used to display the result.

Input range	**0 - 5**
Default value	**2**

Result unit

The result unit is displayed and saved together with the result. It cannot be modified.

Selection	**mL**

7.1.7 Calculations - Methods "Titer Ipol/Upol"

Menu ▸ Parameters ▸ Calculation

Calculation formula

(C00*FCT)/EP1

The calculation formula is predefined and cannot be edited.

The calculated result (value and unit) is saved as the titer of the solution used.

The **Factor (FCT)** parameter must be adjusted according to what is used to determine the titer of the reagent and which unit the sample size has. If the calculation formula is selected and the **[OK]** key is pressed, then a table with the conversion factors will be displayed:

Table 2 Conversion table

Standard used	Sample size in …	Factor (FCT)
Water Standard 10 mg/g	g	Water content in mg/g (see certificate)
Water	g	1000
Water	µL	Density of water in g/mL
Sodium tartrate dihydrate	g	156.6
Sodium tartrate dihydrate	mg	0.1566

Factor (FCT)

Conversion factor, see table above.

Input range	**–999999999 - 9999999999**
Default value	**1.0**

Decimal places

Number of decimal places used to display the result.

Input range	**0 - 5**
Default value	**4**

Result unit

The result unit is displayed and saved together with the result.

Selection	**%** | **ppm** | **mg/mL** | **g** | **mg** | **mL** | **mg/piece** | **User-defined**
Default value	**mg/mL**

User-defined
A user-defined unit can be created. This will be added to the selection list. The previous entry will be overwritten as soon as the new unit has been defined. A blank entry can be generated this way as well.

7.1.8 Calculations - Methods "KFT Ipol/Upol", "KFT Ipol/Upol–Blank"

Menu ▸ Parameters ▸ Calculation

Calculation formula for KFT Ipol/Upol

EP1*TITER*FCT/(C00*DIV)

Calculation formula for KFT Ipol–Blank

(EP1–CV01)*TITER*FCT/(C00*DIV)

Calculation formula for KFT Upol–Blank

(EP1–CV02)*TITER*FCT/(C00*DIV)

The calculation formulas are predefined and cannot be modified.

The **Factor (FCT)** and **Divisor (DIV)** parameters need to be adjusted, depending on the unit used for the sample size and the result. If the calculation formula is selected and the **[OK]** key is pressed, then a table with the conversion factors will be displayed:

Table 3 Conversion table

Result unit	Sample size in …	Factor (FCT)	Divisor (DIV)
%	g	0.1	1
%	mg	100	1
%	mL	0.1	Density of the sample in g/mL
ppm	g	1000	1
ppm	mL	1000	Density of the sample in g/mL
mg/mL	g	Density of the sample in g/mL	1

Result unit	Sample size in …	Factor (FCT)	Divisor (DIV)
mg/mL	mL	1	1
mg/piece	pieces	1	1

Factor (FCT)

Conversion factor, see table above.

Input range	**–999999999 - 9999999999**
Default value	**0.1**

Divisor (DIV)

Conversion factor, see table above.

Input range	**–999999999 - 9999999999**
Default value	**1.0**

Titer

Titer of the solution used. As soon as a solution has been selected under **Titration parameters**, the value and the unit will be read out from the solution data under **System** ▸ **Solutions** and displayed here. If the titer is changed here manually, then the solution data will be updated.

NOTE

Only the numerical value is taken into account in the calculation formula. The calculation will then provide a correct result only if the **unit** of the titer is **mg/mL**.

Input range	**0.00000001 - 9999999999**
Default value	**1.000**

Blank (CV01/2)

This parameter is visible only with the methods **KFT Ipol–Blank** and **KFT Upol–Blank**.

This value is calculated with the blank value determination (methods **Blank Ipol** and **Blank Upol**) and entered here. The value can also be modified manually.

Input range	**–999999999 - 9999999999 mL**
Default value	**0.0 mL**

Decimal places

Number of decimal places used to display the result.

Input range	**0 - 5**
Default value	**2**

Result unit

The result unit is displayed and saved together with the result.

Selection	**%** | **ppm** | **mg/mL** | **g** | **mg** | **mL** | **mg/piece** | **User-defined**
Default value	**%**

User-defined
A user-defined unit can be created. This will be added to the selection list. The previous entry will be overwritten as soon as the new unit has been defined. A blank entry can be generated this way as well.

7.1.9 Statistics

Menu ▸ Parameters ▸ Statistics

The statistics calculation of a multiple determination is switched on under **Statistics** and it is defined how many determinations the series contains.

Statistics

If this funtion is switched on, then statistics calculations will be carried out for all of the defined results.

Selection	**on** | **off**
Default value	**off** For the methods "Titer Ipol" and "Titer Upol" the default value is **on**.

Number of samples

The number of determinations that are carried out for the statistics calculations.

If an additional determination must be added to the determination series, because one determination was incorrect, for example, then this can be accomplished in the statistical overview *(see Chapter 5.8, page 30)*.

Input range	**2 - 20**
Default value	**3**

7.1.10 Reports

Menu ▸ Parameters ▸ Reports

The reports that will be printed out automatically in connection with a determination are defined under **Reports**.

Results

The result report contains the calculated results, equivalence points and endpoints, sample data, etc.

Selection	**on** | **off**
Default value	**off**

Curve

Curve report. The width of the curve is defined in the system settings *(see "Graphics width", page 46)*.

Selection	**on** | **off**
Default value	**off**

Calculations/Statistics

Output of the calculation formulas for the individual results. The results are printed with the maximum resolution. This makes recalculation with an external program possible. The following data is printed out in addition when statistics is switched on:

- Result and sample size of the individual determinations
- Mean value as well as absolute and relative standard deviation

Selection	**on** | **off**
Default value	**off**

Measuring point list

Output of the measuring point list.

Selection	**on** | **off**
Default value	**off**

Parameters

All of the parameters of the current method are printed out with the parameter report.

Selection	**on** | **off**
Default value	**off**

PC/LIMS

The PC/LIMS report is a machine-readable report with all of the data important for a determination. The PC/LIMS report can be saved as a TXT file on a USB storage medium or sent via an RS-232 interface to a LIMS. The output location is defined in the system settings *(see "PC/LIMS report", page 46)*.

The file name of the TXT file is constructed as follows: *PC_LIMS_Report-ID1-YYYYMMDD-hhmmss.txt*.

Selection	**on** | **off**
Default value	**off**

8 Operation and maintenance

8.1 Quality Management and qualification with Metrohm

Quality management

Metrohm offers you comprehensive support in implementing quality management measures for instruments and software. Further information on this can be found in the brochure **"Metrohm Quality Management"** available from your local Metrohm representative.

Qualification

Please contact your local Metrohm representative for support in qualification of instruments and software. The **Installation Qualification** (IQ) and **Operational Qualification** (OQ) are offered by Metrohm representatives as a service. They are carried out by trained employees using standardized qualification documents and in accordance with the currently applicable requirements of the regulated industry. Further information on this can be found in the brochure **"Analytical Instrument Qualification – Confidence in quality with IQ/OQ"**.

Maintenance

The electronic and mechanical functional groups of Metrohm instruments can and should be checked by specialist personnel from Metrohm as part of a regular preventive maintenance schedule. Please ask your local Metrohm representative regarding the precise terms and conditions involved in concluding a corresponding maintenance agreement. Further information on this can be found in the brochure **"Metrohm Care Contracts – Protect your investment the smart way"** available from your local Metrohm representative.

9 Troubleshooting

9.1 Karl Fischer titration

Problem	Cause	Remedy
The drift is very high during conditioning.	*The titration cell is leaking.*	▪ Check seals and septum. If necessary, replace. ▪ Replace molecular sieve.
The drift becomes greater after each titration.	*The sample releases water very slowly.*	▪ Adjust the method. ▪ Add solubilizer. ▪ Increase the temperature (possibly using a KF oven). ▪ See technical literature.
	A side reaction is taking place.	▪ Use special reagents. ▪ Adjust the method (increase/decrease the temperature, external extraction). ▪ See technical literature.
	The pH value is not in the optimum range anymore.	Add buffer, see technical literature.
The titration will not be finished.	*The titration cell is leaking.*	▪ Check seals and septum. If necessary, replace. ▪ Replace molecular sieve.
	The minimum increment is too low.	Define **Titration rate** = **user** and increase the minimum volume increment (**Min. increment**) *(see Chapter 7.1.3, page 53)*.
	The stop criterion is unsuitable.	Adjust the control parameters *(see Chapter 7.1.3, page 53)*: ▪ Increase the stop drift. ▪ Select a short delay time.
	See also: The drift increases after each titration.	

Problem	Cause	Remedy
The sample is over-titrated.	*The increments at the end of the titration are too high.*	▪ Define **Titration rate** = **user** and reduce dosing rate (**Max. rate**) *(see Chapter 7.1.3, page 53)*. The following experiment provides a clue for the optimum dosing rate: During conditioning, display the drift and add sample without starting the titration. Select a value below the highest drift as dosing rate. ▪ Stir faster.
	The amount of methanol in the working medium is too low.	▪ Replace the working medium. ▪ Reduce the amount of solubilizer, if working with solvent mixtures, see technical literature.
	The electrode may be covered.	Wipe off the electrode with ethanol or a suitable solvent.
The solution becomes darker after each titration.		Replace the working medium.
	The electrode may be covered.	Wipe off the electrode with ethanol or a suitable solvent.
	The electrode has a short circuit.	1. Check the Pt wires. 2. Switch on the electrode test.
The endpoint is reached too quickly.	*The dosing rate outside the control range is too high.*	Define **Titration rate** = **user** and reduce the dosing rate (**Max. rate**) *(see Chapter 7.1.3, page 53)*.
The titration times with volumetric titration are constantly longer.	*With two-component reagents the buffer capacity of the solvent can be exhausted.*	Replace the working medium.

9.2 Miscellaneous

Problem	Cause	Remedy
No report is printed.	*The printer is not recognized by the instrument.*	▪ Switch the 870 KF Titrino plus off and on again. ▪ Use a hub on the USB connector and connect the printer to the hub.

Problem	Cause	Remedy
	The printer model is not compatible.	Use a printer which fulfills the required specifications *(see Chapter 10.4.4, page 74)*.
The USB keyboard or the PC mouse does not function.	*The keyboard or mouse is not recognized by the instrument.*	▪ Switch the 870 KF Titrino plus off and on again. ▪ Use a hub on the USB connector and connect the keyboard or mouse to the hub.
	The keyboard or the mouse is not compatible.	Use a model which fulfills the required specifications *(see Chapter 10.4, page 72)*.
The display is no longer readable.	*The contrast is set incorrectly.*	Adjust the contrast correctly *(see Chapter 6.1, page 39)*.
Mettler XP balances send "R" or "O ----" as ID1.	*The automatic calibration of the balance is switched on.*	Switch off the automatic calibration.
Message 020-511 "Action not possible" is displayed.	*The USB stick is no longer connected.*	1. Connect the USB stick. 2. Switch the instrument off and on again.
	The USB stick is full.	▪ Use a different USB stick. ▪ Delete files with the aid of a PC.

10 Appendix

10.1 Exchange unit

10.1.1 Maximum dosing and filling rate

The maximum dosing rate and maximum filling rate for the exchange unit depend on the cylinder volume:

Cylinder volume	Maximum rate
1 mL	3.00 mL/min
5 mL	15.00 mL/min
10 mL	30.00 mL/min
20 mL	60.00 mL/min
50 mL	150.00 mL/min

Independent of the cylinder volume, values ranging from 0.01 to 166.00 mL/min can always be entered. When the function is carried out the rate will be, if necessary, decreased automatically to the highest possible value.

10.1.2 Parameters for the preparing (PREP)

The **PREP** function (Preparing) is used to rinse the cylinder and tubings of the exchange unit and fill them air bubble-free. You should carry out this function before the first determination or once per day.

Preparing is carried out with the following, non-alterable settings:

- The entire cylinder volume is dosed twice with the maximum dosing rate.

10.2 Stirring rate

The stirring rate can be adjusted in steps of –15 to +15.

The approximate rotational speed can be calculated with the following formula:

Rotational speed/min (r/min) = 125 · stirring rate

Example:

Stirring rate set: 8

Rotational speed in rpm = 125 · 8 = 1000

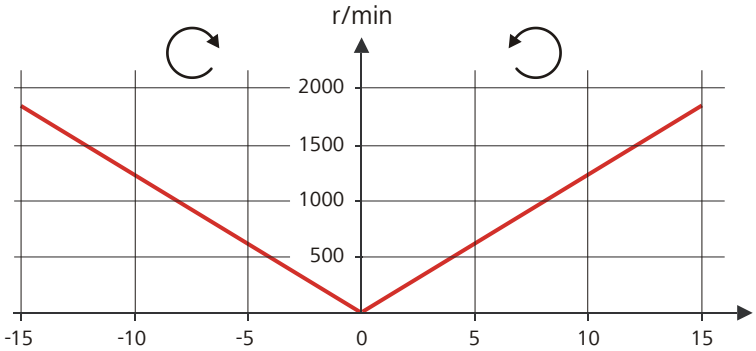


Figure 15 Rotational speed depending on stirring rate

10.3 Balance

The sample size and the associated unit can be sent from a connected balance. The sample size is transmitted as a number with up to ten characters (including algebraic sign and decimal point).

Sample size and unit are sent as a single character string. They are separated by a space character. The string is terminated with the ASCII characters **CR** and **LF**.

If the balance sends a negative sample size (e.g. when you are reweighing a sample), then the algebraic sign is adopted. The algebraic sign is, however, ignored for the calculations.

NOTE

With some balances, the sample identification and the method can be sent in addition to the sample size.

Make sure that the balance does not send the sample size until the end.

Mettler AX

For the Mettler AX balance, the fields that contain the sample identification or the method must be designated as follows:

- Designation for the field with the method name: **METHOD**
- Designation for the field with sample identification 1: **ID1**
- Designation for the field with sample identification 2: **ID2**

10.4 USB devices

NOTE

USB peripheral devices that are to be connected must support either the *USB 1.0/1.1 (Full Speed)* or the *USB 2.0 (High Speed)* standard. The maximum data transfer rate is however in any case 12 MBit/s.

Keyboards, PC mice and barcode readers are so-called HID devices (**H**uman **I**nterface **D**evice) and can be connected via a USB hub only.

Printers should also be connected via a USB hub. Depending on the manufacturer or printer type a direct connection is however possible.

10.4.1 6.2147.000 numerical USB keypad

The **[Num Lock]** key must be pressed for navigating in the dialog. The arrow keys are effective in conjunction with it.

The respective editing dialog must be opened for the numerical input.

Table 4 Key assignment

Key of the 870 KF Titrino plus or function in the editing dialog	Key on the numerical USB keypad
[BACK]	**[Home]**
[⇧] [⇩]	**[↑] [↓]**
[⇦] [⇨]	**[←] [→]**
[OK]	**[Enter]**
[+−]	**[BS]** (backspace)
Clear	**[Del]**
Accept	**[Home]**

10.4.2 Key assignment of a USB keyboard

A commercially available USB keyboard can be connected to make it easier to enter text and numbers.

The respective editing dialog must be opened for the text input and numerical input.

Table 5 Key assignment

Key of the 870 KF Titrino plus or function in the editing dialog	Key on the USB keyboard
[BACK]	**[Esc]**
[⇧] [⇩]	**[↑] [↓]**
[⇦] [⇨]	**[←] [→]**
[OK]	**[↵]** (enter key) *or* **[Enter]** on the numerical keypad
[STOP]	**[Ctrl]** + **[S]**
[START]	**[Ctrl]** + **[G]**
[⇦]	**[←]** (backspace)
Clear	**[Delete]**
Cancel	**[Ctrl]** + **[Q]**
Accept	**[Esc]**

NOTE

The lettering of the USB keyboard may differ from above lettering, depending on the country-specific keyboard used.

10.4.3 PC mouse

In order to make navigating in the dialog of the 870 KF Titrino plus easier, a PC mouse can be connected.

Table 6 Mouse functions

Key of the 870 KF Titrino plus	Mouse function
[OK]	Left mouse button

Key of the 870 KF Titrino plus	Mouse function
[BACK]	Right mouse button
[⇧] [⇩] [⇦] [⇨]	Mouse movement vertical/horizontal
[⇧] [⇩]	Scroll wheel vertical

10.4.4 Printer

The range of USB printers available is extremely varied and constantly changing. The following points must be taken into account when selecting a printer:

- USB interface necessary
- Printer language: HP-PCL, Canon BJL Commands, Epson ESC P/2 or ESC/POS



NOTE

Inexpensive printers are often designed solely for use with a PC and may not be equipped with one of the printer languages listed above. Such models are not suitable for this reason.

10.5 System initialization

In very rare instances, a faulty file system (e.g. because of a program crash) may lead to an impairment of program functioning. The internal file system must be initialized in such cases.



CAUTION

All user data (methods, solutions, etc.) are deleted if a system initialization is carried out. Afterwards, the instrument will have the factory settings again.

We recommend creating a backup of the system at regular intervals in order to avoid data losses.

After a system initialization the program versions and language files do not have to be reloaded. Only the selection of the dialog language may have to be reset in the system settings.

Proceed as follows for the system initialization:

1 Switching off the instrument

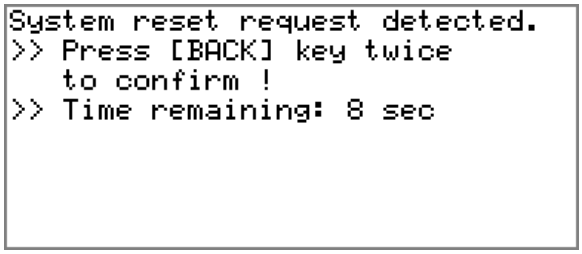
- Keep the red **[STOP]** key pressed down for at least 3 s.

A progress bar is displayed. If the key is released during this time, then the instrument will not be switched off.

2 Switching on the instrument

- Keep the red **[STOP]** key pressed down for approx. 10 s.

The dialog for confirmation of the initialization is displayed for 8 s. The initialization must be confirmed during this time.



3 Confirming the initialization

NOTE

If the request is not confirmed within 8 s, then the procedure will be canceled.

- Press **[BACK]** twice.

Initialization is started. The process takes approximately 80 s. The instrument will be automatically restarted after successful initialization.

10.6 Remote interface

10.6.1 Pin assignment of the remote interface

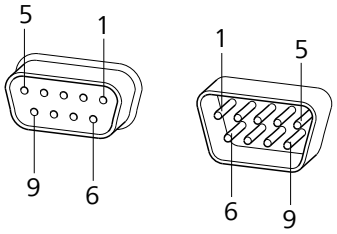


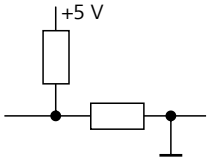
Figure 16 Pin assignment of remote socket and remote plug

The above figure of the pin assignment applies for all Metrohm instruments with 9-pin D-Sub remote connector.

Table 7 Inputs and outputs of the remote interface

Pin No.	Assignment	Function
1	Output 0	Ready/EOD
2	Output 1	-
3	Output 2	Titration
4	Output 3	Cond OK
5	Output 4	Error
6	0 volt (GND)	
7	+5 volts	
8	Input 0	Start
9	Input 1	Stop

Inputs



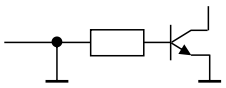
approx. 5 kΩ Pull-up



t_p > 100 ms

active = low, inactive = high

Outputs



Open Collector



t_p > 200 ms

active = low, inactive = high

I_C = 20 mA, V_{CEO} = 40 V

+5 V: maximum load = 20 mA

10.6.2 Status diagram of the remote interface

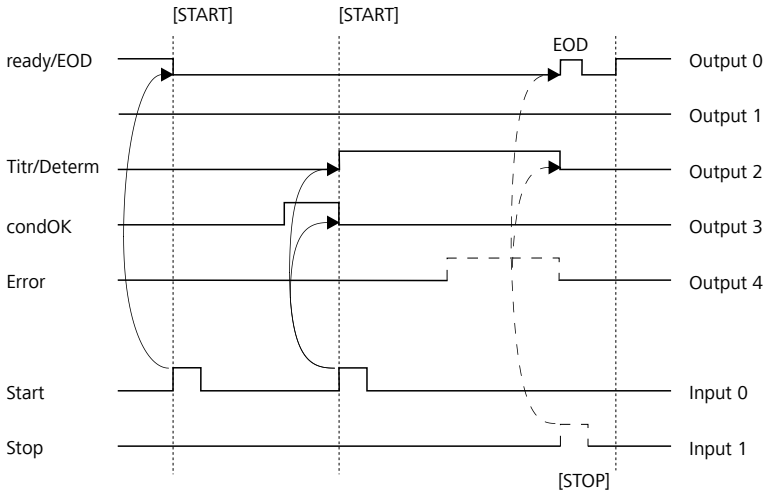


Figure 17 Remote status diagram

EOD = End of Determination

10.7 Remote control via an RS-232 connection

The 870 KF Titrino plus can be remote controlled via an RS-232 connection. For this, a **6.2148.030 RS-232/USB Box** is necessary. Connect the RS-232/USB Box to the USB interface of the instrument.

The RS-232/USB Box has two connectors for RS-232 instruments. The RS-232 remote control functions only through the connector **RS-232/2**. The connector RS-232/1 is designed for connection with a balance. Connect the **RS-232/2** connector of the RS-232/USB Box to a serial interface (COM interface marked with the symbol **IOIOI**) of a PC. Use a **6.2134.040 connection cable**.

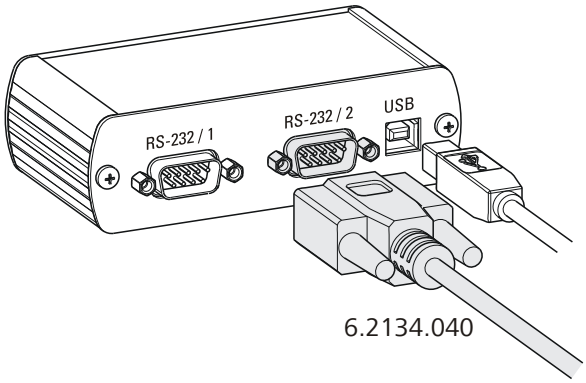


Figure 18 Connecting the RS-232/USB Box to the PC

Interface parameters

We recommend the following parameters for the RS-232 interface **COM2**:

- Baud rate: **19200**
- Data bits: **8**
- Stop bits: **1**
- Parity: **none**
- Handshake: **software**

On the 870 KF Titrino plus, adjust the interface parameters under **Menu ▸ System ▸ External devices ▸ COM2 settings**.

Transfer protocol

The data communication is synchronous. On each command there is an acknowledgement by the instrument.

A command must be sent to the instrument with the control characters **CR LF** as terminator. The acknowledgements of the instrument will also be transferred with **CR LF** as terminator.

The instrument does not send spontaneous messages.

10.7.1 Commands and variables

Command	Function	Comment
$G	Start/Continue	Corresponds to the key **[START]** or **[Continue]**
$S	Stop	Corresponds to the key **[STOP]**
$H	Hold	Hold the method run

Command	Function	Comment
$D	Scan instrument status	Acknowledgements: *Ready;0*, *Busy;0*, *Hold;0* or *Cond;0* (0 = no message) If a message on the instrument requires the interaction of the user, the acknowledgement of the status scan displays the corresponding message number. Example: Busy;010-119 = "Check buret unit" The message can be confirmed with **[OK]** or **[Cancel]**, see below.
$A	Confirm message	Confirm the message on the instrument with **[OK]** A mandatory status scan providing the message number must take place immediately before confirming the message, see above.
$A(OK), **$A(CANCEL)**	Confirm message	Confirm the message with **[OK]** or **[Cancel]**
$A(YES), **$A(NO)**	Confirm message	Confirm the message with **[Yes]** or **[No]**
$L(*method name*)	Load method	The method name has to be known and unique.
$Q(*variable*)	Request variable value	Examples for variables: *EP1*, *R1*, *C00*. List of variables, see below.

Variable	Comment
C00	Sample size
EP1	Volume of the endpoint EP1
CI#	Sample identification (# = 1…2)
R1	Result
CV01	Common variable (blank value at KFT Ipol)
CV02	Common variable (blank value at KFT Upol)
SMN1	Mean value of result R#
TITER	Titer of selected solution

Variable	Comment
CONC	Concentration of selected solution
FCT	Factor
DIV	Divisor
MCV	End volume, i.e. total dosed volume at the end of the titration
EM1	Measured value of the endpoint EP1
ED1	Time at the endpoint EP1
MSV	Start volume
DD	Duration of the entire determination

The values of the variables are only available after the end of a determination (in the status 'ready').

Acknowledgement of the instrument	Comment
OK	Command executed
E1	Method not found
E2	Invalid variable
E3	Invalid command

10.8 Arithmetic algorithms in the 870 KF Titrino plus

Numerical format

The software of the 870 KF Titrino plus calculates in accordance with the widespread standard IEEE 754 (IEEE Standard for Binary Floating-Point Arithmetic for Microprocessor Systems). This means that the numbers are used in calculations in "double precision" (64 bit). Decimal numbers are converted into binary numbers in the computer and used in this form for calculations. The output on the display and in reports once again contains decimal numbers; the binary numbers are thus converted back into decimal numbers. In order to be able to check the internal calculations performed by the computer yourself in accordance with IEEE 754, the numbers are reproduced in the calculation report in complete accuracy. A minimal difference may arise between an originally entered decimal number and the internal computer representation in complete accuracy in the range of the rear decimal places. This difference results from the fact that an exact binary equivalent does not exist for every decimal number. If, for example, you enter the sample size 50.3 mg, this will be depicted in the calculation report in "double precision" with 5.02999999999999E+01.

Rounding-off process

Measured values and results are rounded to the defined number of decimal places (commercial rounding, in accordance with the US Pharmacopeia USP). If the digit at the first dropped decimal place is **1, 2, 3 or 4**, then it will be rounded off; if this digit is **5, 6, 7, 8 or 9**, then it will be rounded up. Negative digits will be rounded in accordance with their amount, i.e. away from zero.

Examples:

2.33 yields **2.3**

2.35 yields **2.4**

2.47 yields **2.5**

–2.38 yields **–2.4**

–2.45 yields **–2.5**

Statistics

The arithmetic mean value and the absolute and relative standard deviations of results are calculated:

You can statistically evaluate a maximum of five results ($1 \leq k \leq 5$) calculated in a determination. A statistical series can contain a maximum of 20 determinations ($1 \leq n \leq 20$).

The following convention applies to the subsequent formulas:

$1 \leq n \leq 20$ and $1 \leq k \leq 5$.

Mean value:

$$\bar{x}_k = \frac{1}{n} \cdot \sum_{i=1}^{n} R_{k,i}$$

Absolute standard deviation:

$$S\,abs_k = +\sqrt{\frac{\sum_{i=1}^{n} \left(R_{k,i} - \bar{x}_k\right)^2}{n-1}}$$

Relative standard deviation (in %):

$$S\,rel_k = 100 \cdot \frac{S\,abs_k}{\bar{x}_k}$$

Explanations

The individual values are incorporated in the statistics with full accuracy.

15 significant places are yielded when the 64 bit numerical format is applied for the floating-point number in decimal presentation.

The accuracy can be controlled by the selection of the prefix of the unit (milli, micro) and the number of decimal places.

Example:

The result displayed, **1234.56789158763 mg/L**, has 15 significant places. It should be rounded off to three decimal places according to the above rounding-off process:

- **1234.568 mg/L**.

If the same result is expressed in "**g/L**" (**1.23456789158763 g/L**), and is also rounded off to three decimal place, this yields

- **1.235 g/L**.

I.e. you obtain the lowest losses in accuracy with rounding when you select the application and the numerical format in such a way that the numbers displayed have as many places before the decimal point as possible.

A complete recalculation of the statistics using a pocket calculator or PC calculation programs may exhibit deviations. This can be explained by the different binary numerical formats used by these computers.

NOTE

The above losses of accuracy by rounding off in the range of significant places are only relevant theoretically. They are generally several orders of magnitude less than measurement technique uncertainties (balance errors, dosing errors, measuring errors).

11 Technical specifications

11.1 Measuring inputs

The measuring cycle is 100 ms for all measuring modes.

11.1.1 Polarizer

A measuring input (**Pol.**) for polarizable electrodes.

Measuring mode Ipol	Determination with adjustable polarization current.
Polarization current	–120 - +120 µA (increment: 1 µA) –125 - –121 µA / +121 - +125 µA: non-guaranteed values, dependent on reference voltage +2.5 V
Measuring range	–1,200 - +1,200 mV
Resolution	0.1 mV
Measuring accuracy	±0.2 mV (±1 digit, without sensor error, under reference conditions)
Measuring mode Upol	Determination with adjustable polarization voltage.
Polarization voltage	–1,200 - +1,200 mV (increment: 10 mV) –1,250 - –1,210 mV / +1,210 - +1,250 mV: non-guaranteed values, dependent on reference voltage +2.5 V
Measuring range	–120 - +120 µA
Resolution	0.01 µA
Measuring accuracy	–

11.2 Dosing drive

Resolution	10,000 steps per cylinder volume
Exchange unit	
Cylinder volume	▪ 1 mL ▪ 5 mL ▪ 10 mL ▪ 20 mL ▪ 50 mL
Accuracy	Fulfills ISO/DIN standard 8655-3

11.3 Interfaces

USB (OTG) connector	For connecting USB devices.
MSB connector	For connecting a stirrer.
Remote connector	For connecting instruments with a remote interface.

11.4 Mains connection

Voltage	100 - 240 V (± 10%)
Frequency	50 - 60 Hz
Power consumption	45 W
Fuse	2 × 2.0 ATH, electronic overload protection

11.5 Safety specifications

This instrument fulfills the following electrical safety requirements:

CE designation in accordance with the EU directives:
- 2006/95/EC (Low Voltage Directive, LVD)
- 2004/108/EC (EMC Directive, EMC)

Federal Inspectorate for Heavy Current Installations ESTI (Accreditation Number SCESp 033)
- Safety mark for certification type 2 in accordance with NEV (type testing with market monitoring, EMC conformity)



ETL Listed Mark:
- Control number 3144965
- UL 61010-1
- CSA-C22.2 No. 61010-1

Design and testing According to EN/IEC/UL 61010-1, CSA-C22.2 No. 61010-1, protection class I, EN/IEC 60529, degree of protection IP40.

Safety instructions This document contains safety instructions which have to be followed by the user in order to ensure safe operation of the instrument.

11.6 Electromagnetic compatibility (EMC)

Emission

Standards fulfilled
- EN/IEC 61326-1
- EN/IEC 61000-6-3
- EN 55022 / CISPR 22

Immunity

Standards fulfilled
- EN/IEC 61326-1
- EN/IEC 61000-6-2
- EN/IEC 61000-4-2
- EN/IEC 61000-4-3
- EN/IEC 61000-4-4
- EN/IEC 61000-4-5
- EN/IEC 61000-4-6
- EN/IEC 61000-4-11
- EN/IEC 61000-4-14

11.7 Ambient temperature

Nominal function range	+5 - +45 °C (at a maximum of 85% humidity)
Storage	–20 - +60 °C
Transport	–40 - +60 °C

11.8 Reference conditions

Ambient temperature	+25 °C (±3 °C)
Relative humidity	≤ 60%
Operating temperature status	Instrument in operation at least 30 min
Validity of the data	After adjustment

11.9 Dimensions

Material of housing	Polybutylene terephthalate (PBT)
Material of display cover	Glass
Width	142 mm
Height	164 mm
Depth	310 mm
Weight	2,950 g

12 Warranty (guarantee)

Metrohm guarantees that the deliveries and services it provides are free of defects in materials, design or manufacturing.

The general warranty period is 36 months (exclusions below) from the date of delivery or 18 months in the event of continuous operation. The warranty remains valid on the condition that the servicing is provided by a service organization authorized by Metrohm at defined intervals and with a defined scope.

The warranty period for anion suppressors of the type "MSM" is 120 months from the date of delivery or 60 months in the case of continuous operation.

The warranty period for IC separation columns is 90 days after start-up.

For third-party components that are recognizable as such, the manufacturer's warranty regulations apply.

Consumables and materials with limited storage life and glass breakage in the case of electrodes or other glass parts are excluded from the warranty.

Warranty claims cannot be asserted if the ordering party has failed to meet its payment obligations according to schedule.

During the warranty period, Metrohm undertakes either to replace free of charge or to credit the purchaser for any modules or components that can be shown to be faulty. Any transport or customs fees that may apply are the ordering party’s responsibility.

The precondition for this is that the ordering party has to specify the article number, the article designation, an adequate error description, the delivery date and (if applicable) the serial number or chip data in the Support Tracker. Metrohm then decides whether a replacement or a credit note is to be issued or whether the faulty part has to be returned using the Return Material Authorization (RMA). If a replacement or credit note is issued, the ordering party undertakes to store the faulty part for at least 24 months in accordance with the current storage directives (in compliance with ESD guidelines) and to hold it in readiness for onsite inspection or for return shipment to Metrohm. Metrohm reserves the right to invoice the ordering party for these articles, including retroactively, in the event of noncompliance with these preconditions.

The same warranty periods that are specified for a corresponding new part apply to parts that are replaced or repaired within the above-mentioned warranty periods. However, replacement or repair of a part does not extend the warranty period of the entire system.

Deficiencies arising from circumstances that are not the responsibility of Metrohm, such as improper storage or improper use, etc., are expressly excluded from the warranty.

Metrohm also offers a 120 month spare parts availability guarantee and a 60 month PC software support warranty, calculated from the date on which the product is withdrawn from the market. The content of this warranty is the ability of the customer to obtain functioning spare parts or appropriate software support at market prices during the time of the warranty period.

If Metrohm AG is unable to meet this obligation due to circumstances beyond the control of Metrohm AG, then the ordering party shall be offered alternative solutions at preferential conditions.

13 Accessories

NOTE

Subject to change without notice.

13.1 Scope of delivery

2.870.0010 870 KF Titrino plus

Qty.	Order no.	Description
1	1.870.0010	**870 KF Titrino plus**
1	6.0338.100	**Double Pt-wire electrode for volumetry** Double Pt-wire electrode, Metrohm plug-in head G, for volumetric Karl Fischer titration and 684/737 Coulometer (cell with diaphragm). Shaft material: Glass Measuring range: –2000 ... 2000 Measuring unit: mV Temperature range, long-term (°C): –20 ... 70 Temperature range, short-term (°C): –20 ... 70 SGJ sleeve: No Shaft diameter top (mm): 8 Shaft diameter bottom (mm): 8 Min. immersion depth (mm): 5 Electrode plug-in head: Metrohm plug-in head G Indicator electrode type: Pt Indicator electrode shape: Wire
1	6.1244.040	**Set of seals**

Qty.	Order no.	Description
1	6.1403.040	**KF Adsorber tube**

Used with KF equipment. Including cover and O-ring.

Height (mm):	113
Outer diameter (mm):	8



Qty.	Order no.	Description
1	6.1414.030	**KF titration vessel lid**

For volumetric KF titrations.

Material:	PTFE
Material remark:	Insert



Qty.	Order no.	Description
1	6.1415.220	**Titration vessel / 20-90 mL**

Material:	Clear glass
Height (mm):	80
Outer diameter (mm):	78
Volume (mL):	20 ... 90



Qty.	Order no.	Description
1	6.1415.250	**Titration vessel / 50-150 mL**

Material:	Clear glass
Height (mm):	80
Outer diameter (mm):	78
Volume (mL):	50 ... 150



Qty.	Order no.	Description
2	**6.1448.010**	**Septum 12 mm, 5 pieces**

Set of 5 items.

Material:	Silicone rubber
Height (mm):	2
Outer diameter (mm):	12



Qty.	Order no.	Description
2	**6.1903.020**	**Stirring bar / 16 mm**

Stirring Bar with magnetic core, PTFE coated, length 16 mm

Material:	PTFE
Outer diameter (mm):	4
Length (mm):	16



Qty.	Order no.	Description
2	**6.1903.030**	**Stirring bar / 25 mm**

Stirring bar with magnetic core, PTFE covering, length 25 mm.

Material:	PTFE
Outer diameter (mm):	5
Length (mm):	25



Qty.	Order no.	Description
1	**6.2104.020**	**Electrode cable / 1 m / F**

For connecting electrodes with Metrohm plug-in head G to Metrohm instruments (socket F).

Length (m):	1



Qty.	Order no.	Description	
1	6.2147.000	**Numerical USB keypad** Numerical USB keypad for Titrino plus, Dosimat plus, 862 Compact Titrosampler, 869 Compact Sample Changer, 863 Compact Autosampler and 899 Coulometer. Including USB hub with two connectors.	
1	6.2151.100	**Adapter USB MINI (OTG) - USB A** For connecting USB instruments.	
1	6.2412.000	**Weighing boats** Weighing boat made of glass for the 6.1414.030 titration vessel lid or the 6.1455.31X, 6.1464.32X, 6.1465.320 titration vessel. For KF water determinations. Including protective tube. Material: Glass Length (mm): 120	
1	6.2723.310	**Protective cover for Titrino plus** Protective cover for display and keypad for all instruments of the Titrino plus family. Suitable for: 848 Titrino plus, 862 Compact Titrosampler, 863 Compact Autosampler, 865 Dosimat plus, 869 Compact Sample Changer, 870 KF Titrino plus, 876 Dosimat plus, 877 Titrino plus, 899 Coulometer. Material: PVC	

Qty.	Order no.	Description
2	6.2730.010	**Screw nipple** Made of PP. For 6.1448.010 Septum or for mounting 6.1403.040 Drying tube or 6.0338.100 Electrode in 6.1414.030 and 6.1414.040 KF Titration vessel lids. Used for KF titrations. Material: PP Inner diameter (mm): 11.5 Length (mm): 23.5
1	6.2730.020	**Septum stopper** With E.301.0041 O-ring. For 6.1448.010 Septum and 6.1414.030 Titration vessel lid. Used for KF applications. Outer diameter (mm): 18 Length (mm): 30
3	6.2730.030	**Stopper** Complete with nipple and E.301.0043 O-ring. For 6.1414.030 titration vessel lid. For KF instruments, VA measurement stands, VA Computrace and IC Dilution. Length (mm): 38
1	6.2739.010	**Wrench** For exchange units. Length (mm): 190

Qty.	Order no.	Description
1	6.2811.000	**Molecular sieve** Molecular sieve. Bottle containing 250 g. Pore size: 0.3 nm. Without moisture indicator. For Rancimats and Karl Fischer instruments.
1	6.6063.901	**Demo CD for tiBase 1.1** Demo CD for tiBase. Test version for 30 days.
1	6.2122.0x0	**Power supply cable with IEC 60320 line socket, type C13** Cable plug according to customer requirements. Switzerland: SEV 1011, Type 12 6.2122.020 Germany, …: CEE 7, Type VII 6.2122.040 USA, …: NEMA 5-15, Type 498 6.2122.070 Length: 1.5 m
1	8.870.8005EN	**870 KF Titrino plus Manual**
1	8.870.8004EN	**870 KF Titrino plus Tutorial**



tiBase

13.2 Optional accessories

Order no.	Description
2.141.0100	**USB Thermal printer Neo's** Compact printer with USB interface for the Titrino plus and Dosimat plus. Paper width 60 mm (40 characters). Including 6.2151.120 USB cable.



Order no.	Description

2.803.0010 803 TI Stand with stirrer and pump



Compact titration stand with magnetic stirrer and built-in pump for solvent addition and aspiration of the titration vessel contents. Suitable for Karl Fischer titrations with Titrandos. MSB connection. Including comprehensive accessories, solvent bottle and waste bottle.

Dimensions in mm (W/H/D): 106/ 101/ 220

Dimensions remark: Height with support rod: 412 mm

2.860.0010 860 KF Thermoprep

The 860 KF Thermoprep is designed for thermal sample preparation in Karl Fischer titration. Numerous substances cannot be analysed by direct Karl Fischer titration as they are not soluble, react with the Karl Fischer reagent or release their water only very slowly or not until heated to high temperatures. Using tightly sealed sample vials, the sample is inserted in the oven. The samples can be subsequently analysed by any volumetric or coulometric KF titrator.

Dimensions in mm (W/H/D): 440/500/230

6.2148.030 RS-232/USB Box



Extends the Titrino plus by two RS 232 interfaces for the connection of e.g. balance, PC, LIMS. Requires 6.2151.030 Cable.

6.3026.150 Exchange Unit 5 mL



Exchange Unit with integrated data chip with 5 mL glass cylinder and light protection. PCTFE/PTFE flat stopcock, FEP tubing connection, anti-diffusion buret tip and standard amber glass reagent bottle.

Volume (mL): 5

Order no.	Description
6.3026.210	**Exchange Unit 10 mL**

Exchange unit with integrated data chip with 10 mL glass cylinder and light protection. PCTFE/PTFE flat stopcock, FEP tubing connection, anti-diffusion buret tip and standard amber glass reagent bottle.

Volume (mL): 10



Order no.	Description
6.3026.220	**Exchange Unit 20 mL**

Exchange unit with integrated data chip with 20 mL glass cylinder and light protection. PCTFE/PTFE flat stopcock, FEP tubing connection, anti-diffusion buret tip and standard amber glass reagent bottle.

Volume (mL): 20



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